

ForeRunner 200E/LE ATM Adapters for the PC User's Manual

MANU0177-02 - Rev. A - December, 1997

Software Version 4.1.x

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- •IEC 1000-4-3 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 3: Radiate electromagnetic field requirements."
- •IEC 1000-4-4 "Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Electrical fast transient/burst requirements."

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ForeRunnerLE 25 -

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PCA-200EPC and ForeRunnerLE 155 -

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PCA-200EPC/SMF

The following information applies to the PCA-200EPC/SMF adapter (single-mode fiber LAN adapter that contains a Class 1 laser):

Class 1 Laser Product: This product conforms to applicable requirements of 21 CFR 1040 at the date of manufacture.

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Preface

This manual provides the necessary information to install the *ForeRunner*TM and *ForeRunnerLE*TM ATM adapters and driver software. Also included is general product information, network configuration information and information about software administration capabilities. This manual is for users with various levels of experience. If you have any questions or problems with the installation, please contact FORE Systems' Technical Support using the information on page iii.

Chapter Summaries

Chapter 1 - Introduction - Provides an overview of ATM, LAN Emulation using ATM, Classical IP, FORE hardware and software, and general information to prepare for the installation of the FORE adapter.

Chapter 2 - Hardware Installation - Provides instructions for installing a FORE adapter card and performing PCI slot configuration.

Chapter 3 - Pre-Installation Checklist - Provides a checklist for the required information for installing the adapter drivers.

Chapter 4 - NetWare Driver Installation - Provides the requirements and instructions for installing the FORE HSM driver for use with the Novell LEC on a system running the Novell 4.11 operating system.

Chapter 5 - Windows NT Installation - Provides the requirements and instructions for installing the FORE adapter drivers on a system running the Microsoft Windows NT 3.51 or 4.0 operating system.

Chapter 6 - Windows 95 Installation - Provides the requirements and instructions for installing the FORE adapter drivers on a system running the Microsoft Windows 95 operating system.

Chapter 7 - Viewing ATM Statistics in Windows NT and Windows 95 - Describes the InFOREmation Center utility for Windows NT and Windows 95, which provides performance monitoring and debugging tools for a FORE adapter running on the Windows NT or Windows 95 operating system.

Appendix A - LED Indicators - Describes the meaning of the LED status indicators on the FORE adapter.

Appendix B - Novell NetWare Network Troubleshooting - Describes troubleshooting techniques for the adapter in a NetWare system.

Appendix C - Network Troubleshooting for Windows NT and Windows 95 - Describes troubleshooting techniques for the adapter in a Windows NT or Windows 95 system.

Appendix D - Possible Values of the ELAN State Field - Describes the possible values of the ELAN state field, which appears in the InFOREmation Center utility.

Appendix E - Running LE Adapter Diagnostics - Describes how to use the hardware diagnostic program included with the *ForeRunnerLE* adapter drivers.

Appendix F - Using the FORE ATM Service Provider with WinSock 2 - Describes how to use the FORE WinSock Service Provider Interface (SPI) provided with the FORE adapter drivers. This SPI can be used with WinSock running on Windows 95 or NT. Use of the SPI requires knowledge of ATM networking and WinSock programming.

Technical Support

In the U.S.A., you can contact FORE Systems' Technical Support by any one of four methods:

1. If you have access to the Internet, you can contact FORE Systems' Technical Support via e-mail at the following address:

support@fore.com

2. You may FAX your questions to "support" at:

724-742-7900

3. You may send questions, via U S Mail, to the following address:

FORE Systems, Inc. 1000 FORE Drive Warrendale, PA 15086-7502

4. You may telephone your questions to "support" at:

1-800-671-FORE

or:

724-635-3700

Technical support for customers outside the U.S.A. should be handled through your local distributor.

When contacting Technical Support, please be prepared to provide your support contract ID number, the serial number(s) of the product(s), and as much information as possible describing your problem or question.

Typographical Styles

Throughout this manual, all specific commands meant to be entered by the user appear on a separate line in bold typeface. In addition, use of the Enter or Return key is represented as **ENTER>**. The following example demonstrates this convention:

cd /usr <ENTER>

File names that appear within the text of this manual are represented in the following style: "... refer to the README.TXT file on the CD..."

Command names and GUI control buttons that appear within the text of this manual are represented in the following style: "Choose the Start button on the Taskbar."

Parameter names that appear within the text of this manual are represented in the following style: "The | < range > is an optional part...."

Any messages that appear on the screen during software installation and network interface administration are shown in Courier font to distinguish them from the rest of the text as follows:

.... Are all four conditions true?

Important Information Indicators

To call your attention to safety and otherwise important information that must be reviewed to insure correct and complete installation, as well as to avoid damage to the FORE adapter or your system, FORE Systems utilizes the following *WARNING/CAUTION/NOTE* indicators.

WARNING statements contain information that is critical to the safety of the operator and/or the system. Do not proceed beyond a *WARNING* statement until the indicated conditions are fully understood or met. This information could prevent serious injury to the operator and damage to the FORE adapter, the system, or currently loaded software, and will be indicated as:

WARNING!



Hazardous voltages are present. To lessen the risk of electrical shock and danger to personal health, follow the instructions carefully.

Information contained in CAUTION statements is important for proper installation/operation. Compliance with CAUTION statements can prevent possible equipment damage and/or loss of data and will be indicated as:

CAUTION



You risk damaging your equipment and/or software if you do not follow these instructions.

Information contained in NOTE statements has been found important enough to be called to the special attention of the operator and will be set off from the text as follows:



Steps 1, 3, and 5 are similar to the installation for the computer type above. Review the previous installation procedure before installation in your particular model.

Safety Agency Compliance

This preface provides safety precautions to follow when installing a FORE Systems, Inc., product.

Safety Precautions

For your protection, observe the following safety precaution when setting up your equipment:

Follow all warnings and instructions marked on the equipment.

Symbols

The following symbols appear in this book.

CAUTION



If instructions are not followed, there is a risk of damage to the equipment.

WARNING!



Hazardous voltages are present. If the instructions are not heeded, there is a risk of electrical shock and danger to personal health.

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Do not make mechanical or electrical modifications to the equipment. FORE Systems, Inc., is not responsible for regulatory compliance of a modified FORE product.

CHAPTER 1

Introduction

This chapter provides an overview of the ATM Standard, the LAN Emulation Over ATM Standard, Classical IP, and the following adapters:

- ForeRunnerLE 25 and 155 Mbps adapters for the PCI bus (also referred to as the LE adapters)
- ForeRunner PCA-200EPC adapters for the PCI bus (also referred to as the PCA adapter)

Hardware and software requirements and the contents of the LE and PCA packages are also discussed.

1.1 Overview of the ATM Standard

Asynchronous Transfer Mode, or ATM, is a communication architecture based on the switching of small fixed length packets of data called *cells*. In ATM, all data is transferred in 53-byte cells. Each cell has a 5-byte header that identifies the cell's route through the network and 48-bytes containing user data. This user data, in turn, carries any headers or trailers required by higher level protocols.

Perhaps the single most important advantage offered by ATM, in addition to data transfer speed, is its open-ended growth path. ATM is not locked into a single physical medium or speed. The fixed-size ATM cell allows traffic from multiple sources (simultaneous video, audio, and data communication) to be switched to multiple destinations by fast ATM switches. For example, a *ForeRunner* ASX-1000 ATM Switch can connect up to 96 users and has an aggregate capacity of 10 gigabits per second. Larger LANs can be built by interconnecting multiple *ForeRunner* ATM switches.

1.2 Overview of LAN Emulation

FORE System's *ForeThought* 4.1 LAN Emulation (LANE) software is compliant with the ATM Forum's *LAN Emulation Over ATM Version* 1.0 specification. LAN Emulation allows higher level protocols and LAN applications to interoperate, without modifications, with an ATM network. The LANE components, running on the ATM network, work together to emulate an Ethernet or Token Ring LAN. This emulated Ethernet or Token Ring LAN is called an *emulated LAN (ELAN)*. The ELAN components resolve MAC addresses to ATM addresses, replace the connectionless operation of legacy LANs with point-to-point connections, and provide broadcast and multicast services. The ELAN consists of a LAN Emulation Client (LEC) running on each host in the ELAN, and the following LANE Services:

- the LAN Emulation Server (LES)
- the Broadcast and Unknown Server (BUS)
- the LAN Emulation Configuration Server (LECS)

In *ForeThought* 4.1, the LANE services operate on a FORE Systems switch or SunOS or Solaris workstation. *ForeThought* 4.1 uses UNI 3.0 or 3.1 signalling.

In order to understand *ForeThought* 4.1, it is important to understand how these components work together to provide LAN Emulation.

1.2.1 The ELAN Components

The ELAN includes a number of components:

LAN Emulation Client (LEC)	Runs	on	each	end	station	in	the	ELAN.
	Comm	unica	ates wi	th oth	er ELAN	con	npone	ents (the
	LES ar	nd BU	JS) to 1	esolve	MAC ac	ldres	ses ir	nto ATM
	addres	sses.						

LAN Emulation	Runs on a SunOS or Solaris workstation or in a FORE
Configuration Server (LECS)	Systems switch. Maintains information about all
	ELANs within the administrative domain. When the
	LEC successfully communicates with the LECS, the
	LECS provides a list of ELANs which the LEC can
	ioin

join.

LAN Emulation Server (LES)

Runs on a SunOS or Solaris workstation or in a FORE
Systems switch. Maintains information about the
LECs within a single ELAN and performs address

resolution.

Broadcast and Unknown Server (BUS)

Runs on a SunOS or Solaris workstation or in a FORE Systems switch. Provides services within a single ELAN allowing broadcasts, multicast, and unknown unicasts within a single ELAN.

1.2.2 An Example Configuration

The diagram in Figure 1.1 shows an example configuration of a single ELAN in a FORE network. The ELAN includes:

- Workstations (PCs and UNIX boxes) running a LEC. Each has a ForeRunner ATM adapter, the ForeRunner driver for the adapter, and one or more ForeRunner ELAN drivers installed.
 - On a NetWare host, the *ForeRunner* HSM driver and the Novell LEC driver are installed.
- Two ASX-200 switches, on which the LANE services are running. One switch is running the LECS, the LES, and the BUS. Both switches are also running LECs.
- A Powerhub 7000 providing access to non-ATM networks.

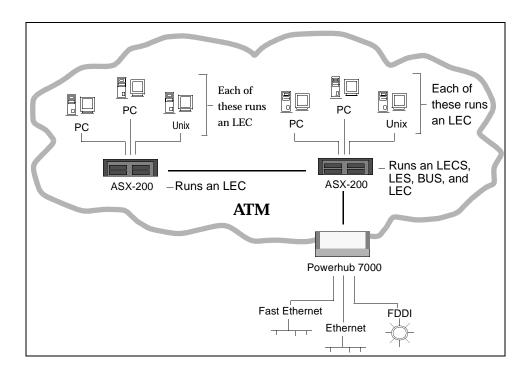


Figure 1.1 - An Example of an ELAN

1.2.3 The Initialization Process

The LEC running on the workstation goes through the following process when it starts up:

- 1. The LEC obtains its own ATM address via ILMI address registration.
 - Optionally, you can manually specify the ATM address when you install the *ForeRunner* ATM adapter driver.
- 2. The LEC establishes a connection to the LECS using the well-known address or the Permanent Virtual Circuit (0,17).
 - Optionally, you can manually specify the address of the LECS when you install the *ForeRunner* ELAN driver.
- 3. The LEC requests the information necessary to join a specified ELAN or the default ELAN. The LECS has information about available ELANs, what ELANs each LEC can join, and which ELAN the LEC should attempt to join first.
 - If the LECS is not available, or if you choose not to use it, you can manually specify the LES address for an ELAN.
- 4. The LEC contacts the LES associated with the ELAN it wants to join and registers its MAC-NSAP address pair. It also contacts the BUS associated with the ELAN. At this point, the LEC and the LES have the information required to allow this host to communicate with other hosts on the ELAN as if it were an Ethernet or Token-Ring network, and vice versa. Refer to "The Connection Process" on page 1-4 for a description of how it connects to other hosts on the ELAN.

1.2.4 The Connection Process

To send Ethernet or Token-Ring packets to another host on the ELAN:

- The LEC calls the LES to map the MAC destination address into an ATM NSAP address. (The LES maintains a mapping table of the address of all LECs on the ELAN.)
- 2. If the LES finds an entry in its table for the destination MAC address, it returns the destination NSAP address to the LEC.
- 3. The LEC then opens up a point-to-point ATM connection to the destination host to send the packet.

1.2.4.1 Multicast and Broadcast Packets

For outgoing multicast and broadcast packets, the LEC sends them to the BUS which uses a point-to-multipoint connection to send the packet to multiple NSAP addresses in the ELAN.

1.2.5 Multiple ELANs

It is possible to set up more than one ELAN in a FORE network. For each new ELAN, you must configure another LES and BUS instance for that LAN. On the access devices, bridge groups must be used to associate physical Ethernet ports with ELANs on the ATM side.

An end station with a ForeRunner adapter can connect to a number of ELANs simultaneously:

- If running Windows NT, the end station can connect to a maximum of 16 ELANs simultaneously. (If you are also using IP Over ATM drivers, you can install a combined total of 16 ELAN and IP Over ATM connections).
- If running Windows 95, the end station can connect to a maximum of 4 ELANs simultaneously.

1.2.6 Failover ELANs

To ensure that a single service failure does not cripple the entire ELAN, *ForeThought* 4.1 supports a simple failover mechanism. Rather than associating a single LES and BUS pair with a single ELAN, the LEC maintains an ordered list of LES and BUS pairs for each ELAN. While the LEC is only interacting with one LES at a time, it is ready to move to the next LES and BUS in the list if the current LES fails. If it is using a backup LES and BUS pair, the LEC will periodically check if the primary LES and BUS pair in the failover sequence are again available. If they are, the LEC resumes the connection to the original pair.



Failover ELANs are supported on Windows NT and 95. They are not supported by the Novell LEC.

1.2.7 Automatic ELAN Selection

To simplify configuration of the ELAN, *ForeThought* 4.1 allows a host to join an ELAN without specifying an ELAN name. If the LECS has been configured to provide the required information, and you do not manually specify an ELAN name to join when you configure the ELAN driver, the host initially attempts to join the ELAN specified by the LECS. The other parameters that you have configured for the ELAN driver, ELAN Type and MTU size, must match that specified by the LECS.

The host successfully joins the ELAN under the following conditions:

- · the LECS is available
- the proper LES address for the ELAN has been specified in the LECS
- · the LES and BUS are available
- the host is configured with LAN Type and MTU Size parameters that match that
 of the ELAN.

Only one ELAN driver can use automatic ELAN selection. When configuring other ELAN drivers, you must specify the ELAN name.



Although the LECS can provide the name of the ELAN to the end host, the LECS cannot supply the host's TCP/IP address for the interface. If you are using automatic ELAN selection and TCP/IP, you must still get the appropriate TCP/IP address for your host on that ELAN.

1.3 Overview of Classical IP (Windows 95 and NT)

FORE System's *ForeThought 4.1* IP Over ATM software (available for Windows 95 and Windows NT) is compliant with the RFC 1577 specification for Classical IP. The term *classical* indicates that the ATM network has the same properties as existing legacy LANs. That is, even though ATM technology allows for large globally connected networks, for example, it is only used in the LAN environment as a direct replacement of existing LAN technology. The classical model of LANs connected through IP routers is maintained in Classical IP over ATM networks.

Classical IP over ATM is different than IP in legacy LANs in that ATM provides a virtual connection environment through the use of PVCs and/or SVCs. SVC management is performed via UNI 3.0 or 3.1 signalling. UNI is a broadband signalling protocol designed to establish connections dynamically. UNI uses Service Specific Connection Oriented Protocol (SSCOP) as a reliable transport protocol, and all signalling occurs over VPI: 0, VCI: 5. UNI connections are bi-directional, with the same VPI/VCI pair used to transmit and receive. Currently, FORE Systems supports UNI signalling as defined by the ATM Forum UNI 3.0 or 3.1 specification.

Once a Classical IP connection has been established, IP datagrams are encapsulated using IEEE 802.2 LLC/SNAP and are segmented into ATM cells using ATM Adaptation Layer type 5 (AAL5). In addition, the default Maximum Transmission Unit (MTU) is 9,180 bytes (the SNAP header adds 8 more bytes) with a maximum packet size of 65,535 bytes. There is currently no support for IP broadcast datagrams or IP multicast datagrams in a Classical IP environment.

1.3.1 Logical IP Subnets

An important concept in Classical IP networks is that of a Logical IP Subnet (LIS). An LIS is a group of hosts configured to be members of the same IP subnet (that is, they have the same IP network and subnetwork numbers). In this sense, one LIS can be equated to one legacy LAN. It is possible to maintain several overlaid LISs on the same physical ATM network. Therefore, in a Classical IP ATM network, placing a host on a specific subnet is a logical choice rather than a physical one. In this type of environment, communication between hosts in different LISs is only permitted by communicating through an IP router which is a member of both LISs (as per RFC-1577).

The number of LISs, and the division of hosts into each LIS, is purely an administrative issue. Limitations of IP addressing, IP packet filtering, and administrative boundaries may guide a manager into establishing several LISs onto a single ATM network. Keep in mind, though, that communication between LISs must occur through IP routers.

1.4 PCA Adapter Overview

The PCA-200EPC adapter, shown in Figure 1.2 is a high-performance, single-slot ATM adapter designed for use on a PCI bus. The PCA adapter features FORE Systems' Advanced Cell Processing Architecture and provides maximum networking performance to applications running on PC systems. The firmware for the PCA adapter can be downloaded, allowing convenient upgrades to support evolving signalling and AAL standards. In addition, the PCA adapter provides transparent support for various networking protocols, Switched Virtual Circuits (SVCs) through the UNI 3.0/3.1 protocol, and Permanent Virtual Circuits (PVCs).

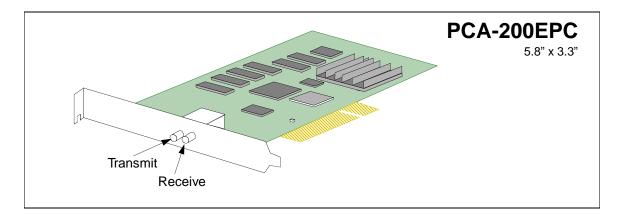


Figure 1.2 - PCA-200EPC Adapter

1.4.1 Hardware Overview

The Advanced Cell Processing Architecture featured in the PCA adapter uses a dedicated embedded Intel i960 RISC processor, along with special-purpose AAL 5 and 3/4 Segmentation and Reassembly (SAR) hardware, and fly-by, scatter-gather DMA. The adapter provides PCI bus master burst transfers. The adapter enables users to add ATM networking capabilities to their applications leaving the low-level ATM cell processing, segmentation and reassembly, and signalling to the adapter hardware and device driver.

1.5 LE Adapter Overview

The *ForeRunnerLE* 25 and 155 adapters (shown in Figure 1.3) are high-performance, single-slot ATM adapters. They use a 32-bit, 33 MHz PCI-bus architecture with integrated SAR and PCI-bus mastering capabilities. Using single-sided SMT technology, the adapter consists of three basic elements, the SAR+PCI bus interface, the physical media chip, and the physical media interface.

The same FORE ATM driver is used for either version of the LE adapter.

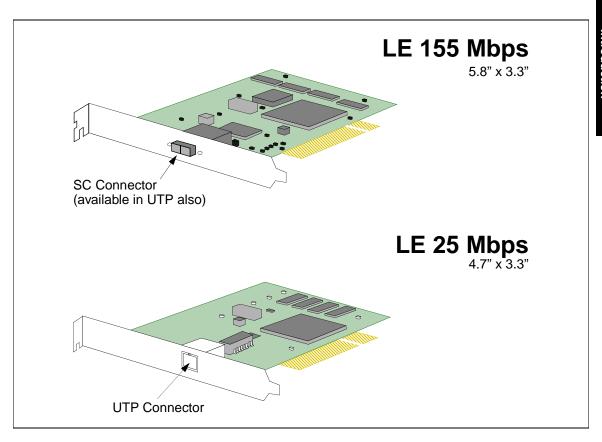


Figure 1.3 - ForeRunnerLE Adapters

1.6 Hardware Requirements

Hardware requirements for the ForeRunner and ForeRunnerLE adapters are shown in Table 1.1.

 Table 1.1 - ForeRunner and ForeRunnerLE Hardware Requirements

Adapter	Supported Platforms	Bus Slot	Minimum RAM
ForeRunnerLE	Intel 80386, 80486, or Pentium,	PCI 2.0/2.1	16M
ForeRunner PCA-200EPC	DEC Alpha ¹	Bus Master	101/1

^{1.} DEC Alpha is supported on Windows NT only.

1.7 Supported Operating Systems

The *ForeRunner* and *ForeRunnerLE* adapter driver can be installed on:

- Microsoft Windows NT, Version 3.51
- Microsoft Windows NT. Version 4.0
- Microsoft Windows 95
- Novell NetWare, Version 4.11 IntraNetWare (with the Novell LEC on the PCA-200EPC adapter only)

1.8 Software Overview

The FORE Windows NT and Windows 95 adapters use *ForeRunner's* market-proven support for various network protocols, allowing existing applications to operate with no modifications. Major advantages include high-performance network throughput delivered to applications and the flexibility for future upgrades.

The software drivers are based on the ATM Forum UNI 3.0 and 3.1 specification. In addition, the Emulated LAN driver is compliant with the ATM Forum document *LAN Emulation Over ATM*, *Version 1.0*. The Classical IP Over ATM driver, available for Windows 95 and Windows NT, is compliant with RFC 1577. The software is provided on CD.

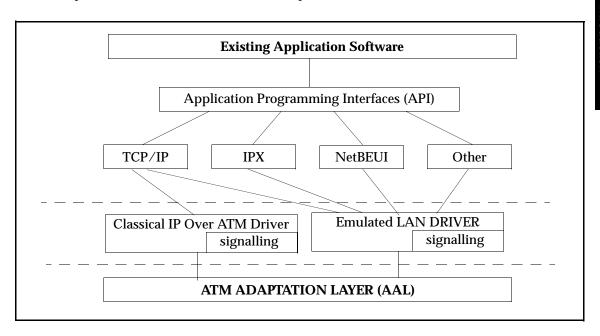


Figure 1.4 - Software Architecture



The *ForeRunner* software CD includes the FORE HSM driver for use with the Novell LEC. This is a "thin" driver that can be used with the PCA-200EPC adapter and Novell's LEC software.

1.9 Fiber-Optic Cable Specifications

The PCA and LE 155 Mbps adapters are available with fiber-optic connectors. Table 1.2 lists the recommended cable specifications to ensure optimal adapter and switch performance. These specifications do not apply to the LE 25 Mbps adapters, which do not support fiber optic connectors.

Table 1.2 - Fiber-Optic Cable Specifications

Description	Specification for Multi-Mode Products
Core Diameter	62.5 μm
Fiber Diameter	125 μm
Wavelength	1310 nm
Loss Characteristic	~0.5 dB/km
Connector Style	SC or ST
Power Budget	11 dB ¹
Approximate Distance	2 km
Transmit Power	-19 dBm (minimum)
Receive Power	-30 dBm (minimum)

 $^{^{1.}}$ If a 50 mm core fiber is used, the power budget is derated by 4 dB.

1.10 UTP Specifications

The LE and PCA adapters are available with RJ-45 connectors for use with UTP category 5 cable. The UTP cable specifications are shown in Table 1.3.

Table 1.3 - UTP Category Cable Specifications

Description	Value
AWG	24
Impedance (Ω)	100 ±15%
Attenuation (dB/1000 ft. Max)	25 dB @ 16 mHz
	52 dB @ 62.5 mHz
	67 dB @ 100 mHz
Maximum Run	100 m ¹
Connector Style	RJ-45

 $^{^{1\}cdot}$ Within the 100 meter run, a maximum of two connections is permissible.

The pinouts for the RJ-45 connector on a LE or PCA adapter are shown in Table 1.4.

Table 1.4 - RJ-45 Connector Pinouts

Pin Number	Transmit/Receive
1	Transmit (+)
2	Transmit (-)
3 - 6	Not Used
7	Receive (+)
8	Receive (-)

1.11 Single-Mode Fiber Specifications

The PCA-200EPC adapters are available with single-mode fiber (SMF) connectors. Table 1.5 and Table 1.6 provide the specifications of the transmitter and receiver optical interfaces on the supported hardware. Table 1.7 provides interconnecting link specifications.

Transmitter Optical Interface Specifications		
Wavelength	1261 - 1360 nm	
Spectral Width	7.7 nm rms (maximum)	
Mean Launch Power	-15 to -8 dBm	
Extinction Ratio	8.2 dB (minimum)	

Table 1.5 - SMF Transmitter Interface Specifications

Receiver Optical Interface Specifications		
Sensitivity	-28 dBm (minimum)	
Overload	-8 dBm (minimum)	
Optical path power penalty	1 dB	

Table 1.6 - SMF Receiver Interface Specifications

Interconnecting Link Specifications		
Connector Type	Duplex SC	
Fiber Specification	Per CCITT recommendation G.652, also known as EIA Class IVa	
Mode Field Diameter	9 - 10 micrometers	
Fiber Cladding Diameter	125 micrometers	
Fiber Loss Characteristics	1.0 dB/km (typical)	
Power Budget	12 dB	
Maximum Link Length (@1.0 dB/km)	10 km (includes 2 dB connector loss)	

Table 1.7 - SMF Interconnecting Link Specifications

1.12 Unpacking Information

When you receive the adapter, inspect the package for any shipping damage. If the package shows any signs of external damage and/or rough handling, notify your carrier's representative.

When unpacking the adapter package, be sure to keep all original packing materials. They may be needed for storing, transporting, or return of the product.

CAUTION



All products returned to FORE Systems, under warranty, must be packed in their original packing materials.

Verify the package contents. The following items should be included:

- LE or PCA adapter
- ForeThought software CD
- FORE PC Adapter Quickstart Guide
- Release Notes

If any of the above items are missing or damaged, please contact FORE Systems' Technical Support immediately.

Keep the adapter in its anti-static protective bag until installation. Electronic components are subject to damage from even small amounts of static discharge. Be sure to use an anti-static grounding strap and properly ground the equipment when installing the adapter.

CAUTION



To avoid equipment damage due to electrostatic discharge, use an anti-static grounding strap when handling this, or any other electronic components. Handle the adapter only by the edges, avoiding all components and metal parts.

CHAPTER 2

Hardware Installation

This section provides procedures for installing a *ForeRunner* or *ForeRunnerLE* ATM adapter in a PC. These adapters are listed in Table 2.1.

Table 2.1 - ForeRunner and ForeRunnerLE PC Adapters

Adapter	Bus Requirement	
ForeRunnerLE (also referred to as the LE adapters)	PCI 2.0/2.1	
ForeRunner PCA-200EPC and PCA-200PC (also referred to as the PCA adapters)	Bus Master Slot	

Please read all information carefully before attempting installation.

2.1 General Installation Procedures

Installation of an LE or PCA adapter into a PC is a simple procedure. However, because there are wide variations in the procedures used to open the various PC system units, these instructions provide the common steps for all PCs. These instructions may not exactly match the procedure for your specific PC.



Whenever installing a FORE adapter into a PC, please refer to your PC system User's Manual for additional installation information.

2.1.1 PCI Slot Configuration

Some PCs may have a BIOS that requires configuration of the PCI slot. PCs with a BIOS that conforms to the Plug & Play standard will probably not require PCI slot configuration. However, for those BIOSs that **DO** require slot configuration, refer to the PC documentation for configuration instructions. If the PCI slot requires configuration, you must perform the configuration prior to installing the driver software.

2.2 Shutting Down the PC

Before installing an LE or PCA adapter, you must shut down the PC using the following procedure.

CAUTION



The PC should be shut down in an orderly manner. Always quit all open applications and user processes. Improperly quitting an application may damage files.

- Save all work and exit any open applications.
- Shut down the PC in an orderly manner.
- 3. Turn off the PC and any attached peripherals.
- 4. Unplug the AC power cord from the PC.



For additional information about shutting down the PC, please refer to your PC system User's Manual.

2.3 Hardware Installation

This section provides the information necessary to install an LE or PCA adapter into a PC. These installation procedures reflect the common steps needed for installing the adapter card, regardless of the target system.

2.3.1 Opening the System Unit

CAUTION



Electronic components are extremely sensitive to static electricity. You should wear a properly grounded anti-static strap while installing the adapter card. This can prevent electrostatic discharge damage to the adapter and other static-sensitive electronic components.

Perform the following steps to open the system unit:

- 1. Shut down the PC as described in Section 2.2.
- 2. Follow the instructions in your PC system User's Manual to allow access to the PC's card bay. A typical card bay is shown in Figure 2.1.

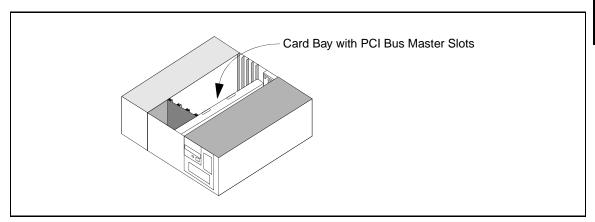


Figure 2.1 - Card Bay

2.3.2 Installing the Adapter

Perform the following steps to install the LE or PCA adapter:

- 1. Ground yourself to a metal part of the PC chassis using a grounding wrist strap.
- 2. Locate the PCI expansion slots, as shown in Figure 2.2. (The PCA and LE adapters can be installed in a PCI bus master slot *only*).
- 3. If necessary, remove the cover plate at the rear of the PC to allow the adapter to be inserted.
- 4. Align the connector side of the board with the metal grooves of the PCI slot.
- Align the fiber-optic or UTP connectors on the board with the connector opening in the back of the PC case.
- 6. Push the board into the PCI slot until the connector is firmly seated, as shown in Figure 2.2.

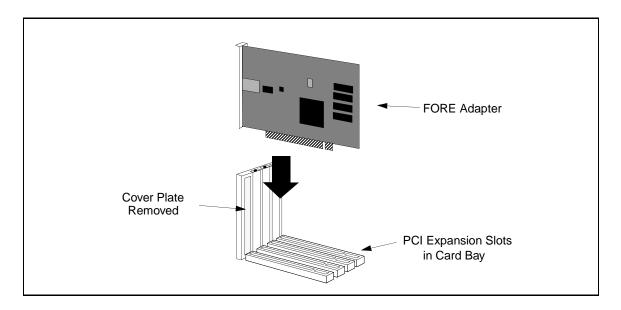


Figure 2.2 - Inserting the Adapter into the Connector Slot

- 7. Secure the board to the chassis, using a screw or clip, depending on the method used by your PC. A screw opening is located on the metal bracket attached to the FORE adapter.
- 8. Close the case, replacing the panels you removed in Section 2.3.1. Refer to your PC system User's Manual for more information.



If you are installing a PCA or LE adapter, current implementations of the PCI bus typically provide for automatic slot configuration. Earlier implementations of the PCI bus may require manual slot configuration. Please refer to your PC system User's Manual.

The adapter hardware installation is complete and you can proceed to connect the adapter to the ATM switch and install the FORE software driver for your operating system.

Hardware Installation

CHAPTER 3

Pre-Installation Checklist

Review the following sections before you install the *ForeRunner* and *ForeRunnerLE* adapter (listed in Table 3.1) software drivers. The pre-installation checklist helps determine the information required for your installation, including ATM addresses that you will need. Get any ATM addresses, and other required information, from your system administrator. This chapter also includes a description of an ATM address.

Table 3.1 - ForeRunner and ForeRunnerLE PC Adapters

Adapter	Bus Requirement	
ForeRunnerLE (also referred to as the LE adapters)	PCI 2.0/2.1	
ForeRunner PCA-200EPC and PCA-200PC (also referred to as the PCA adapters)	Bus Master Slot	

3.1 UNI and ILMI Configuration

The version of the UNI signalling protocol used by the adapter must match that used by the switch to which it is connected. By default, the FORE ATM driver is configured to use the ILMI protocol to automatically determine which version of UNI to use, 3.0 or 3.1. If your site is not using ILMI, when you configure your driver not to use ILMI the UNI version automatically reverts to UNI 3.0. If the switch to which the adapter is connected is using UNI 3.1, you must manually configure the driver to use UNI 3.1.

3.2 Pre-Installation Checklist

Please review the following checklist of required information.

Table 3.2 - Information Required for Installation

Are you	You must know
Installing more than one adapter card?	 The relative position of each adapter card in the PCI slots. Which ELANs or Classical IP LISs you want to access through each adapter card.
Not Using ILMI?	• You must specify the ATM address for all adapter cards. If the switch is not using UNI 3.0, you must specify the UNI version.
	You do not have to specify an ELAN name, or any other ELAN information if a automatic ELAN name has been configured on the LECS. Ask your system administrator for this information.
Connecting to an emulated LAN?	 The name of each ELAN to which you want to connect (if not using the Automatic ELAN Name feature). If you have multiple adapters, know which adapter connects to each ELAN. The ELAN media type (Ethernet or Token-Ring) of each ELAN to which you want to connect. The failover range for each ELAN, if one has been specified. If you are not using the well-known address or PVC (0.17) to determine the address of the LECS, you must know the ATM address of the LECS. If you are not using the LECS, you must know the ATM address of the LES.
Connecting to a Classical IP LIS? ¹	The ATM address of the ARP Server for each Classical IP LIS to which you want to connect. If you have multiple adapters, know which adapter connects to each LIS.

^{1.} Windows NT and Windows 95 only

3.2.1 Multiple Adapters Worksheet

You may copy Table 3.3 to use as a worksheet to record information about your adapter cards and ELANs. You can use this information when you perform the driver installation for the operating system you are using. You will have to get some of this information from your system administrator.

PCI Slot Number Write down the number of the PCI slot that contains

the adapter.

ELAN(s) or LIS(s) on Adapter Write down the name of each ELAN or LIS to which

this adapter will connect. (The total number of ELANs or LISs to which you can connect depends on

your operating system.)

Failover Range Write down the failover range of each ELAN, if

failover ranges have been defined.

Table 3.3 - Multiple Adapters/ELANs/LISs Worksheet

PCI Slot Number	ELAN(s) or LIS(s) on Adapter	ELAN Failover Range

3.3 How to Specify an ATM Address

Depending on whether you're using ILMI and the LANE services, you may have to specify one or more ATM addresses when installing the adapter drivers. The ATM address is 20 bytes in length and is specified as 40 hexadecimal characters. The logical components of an ATM address are:

• The *switch prefix*, consisting of the first 13 bytes, which is typically the same for all ports on a single switch. For example:

47000580ffe1000000f2150f5b

• The *end system identifier (ESI)*, consisting of bytes 14 through 19, which usually is the six-byte hardware MAC address of a particular adapter card. For example:

002048102aef

The selector byte, the last byte of the ATM address. For example:

0a

The following is a sample of the entire ATM address:

47000580ffe1000000f2150f5b002048102aef0a

If you are specifying the address in NetWare, Windows NT, or Windows 95, you can use periods to separate the logical components of the address:

47000580ffe1000000f2150f5b.002048102aef.0a

The periods used in the sample address above are included to make the address easier to read. Their use is not required, and they can be placed at irregular intervals as frequently as every byte.

3.4 Usage of Match.Ordering with Automatic ELAN Selection

To assure proper operation of the Automatic ELAN Selection feature, the Match.Ordering statement must list ELANs in order of decreasing MTU size. The Match.Ordering statement is in the LECS.CFG file, on the machine on which the LECS is running. It is edited when the system administrator configures the LECS.

When using Automatic ELAN Selection, the Match.Ordering statement determines which ELAN the client will join. The client will join the first ELAN in the Match.Ordering list with which it is compatible that has a configured MTU size that is equal or lesser than that specified on the client. To ensure that the client only joins an ELAN with a matching MTU size, the Match.Ordering statement must list ELANs in order of decreasing MTU size. Otherwise, the client will join the first ELAN with an MTU size that is lower than or equal to that defined in the client.

For example, the Match.Ordering statement indicates the following ELANs with the indicated MTU sizes:

Match.Ordering: ethernet1516, ethernet4544, ethernet9234, ethernet18190

If the ELAN driver on the client is configured as Ethernet with an MTU size of 18190, that client will join ethernet1516, because that is the first ELAN in the list with an MTU size that is lower than or equal to that defined in the client.

To ensure that the client joins the ELAN that matches its configured MTU size, the Match.Ordering statement must be re-ordered:

Match.Ordering: ethernet18190, ethernet9234, ethernet4544, ethernet1516

Pre-Installation Checklist

CHAPTER 4

NetWare Driver Installation

This chapter describes how to install the FORE ATM HSM (Hardware Specific Module) driver for use with the PCA-200EPC ATM adapter and NetWare 4.11. The FORE ATM HSM allows the PCA-200EPC to be used with the Novell LAN Emulation Client (LEC). The Novell LEC is an ATM Forum compliant software stack that supports Ethernet and Token Ring LAN Emulation. To use the Novell LEC with the PCA-200EPC, you must first install the HSM, as described in this chapter.

Installation of the HSM can be performed by using the NetWare INETCFG utility, or by manually copying files from a DOS or Windows attached NetWare client and then editing the AUTOEXEC.NCF file. Both methods are described in this chapter.

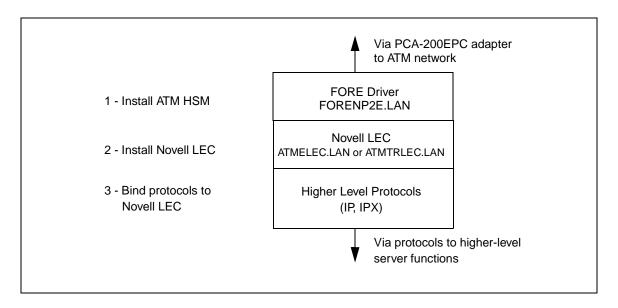


Figure 4.1 - FORE and Novell Driver Configuration



The FORE ATM HSM driver can only be used with the PCA-200EPC adapter. It cannot be used with a *ForeRunnerLE* adapter.

4.1 Installation Using INETCFG

4.1.1 Step One: Install and Configure the FORE HSM

1. Insert the *ForeThought* software CD into the CD-ROM drive.



If you must install the drivers from a diskette, copy the FORENP2E.LAN and FORENP2E.LDI files from the \NETWARE directory of the CD to a diskette.

2. From the NetWare console prompt, add a search path to indicate the directory containing the drivers corresponding to your adapter:

search add g:\netware

In this example, the CD-ROM drive is indicated by g:\. Be sure to indicate the correct path for your CD-ROM drive or floppy drive.

3. Load the INETCFG module:

LOAD INETCFG

- 4. Select Boards. The Configured Boards list appears (it might be empty if you have no configured adapters on your server).
- 5. Press the <Insert> key. A list of adapter drivers appears.
- 6. Press the <Insert> key again. The New Driver window appears.
- 7. Specify the name the FORE HSM driver file, FORENP2E, as shown in Figure 4.2. The INETCFG utility proceeds to copy the FORENP2E.LAN and FORENP2E.LDI files to the SYS:SYSTEM partition of the NetWare server.

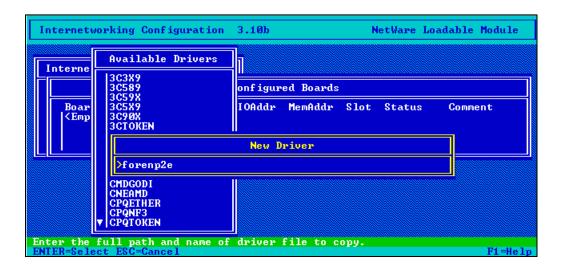


Figure 4.2 - Installing the FORENP2E Driver

8. Select FORENP2E from the list of available drivers. The Board Configuration window appears, as shown in Figure 4.3.

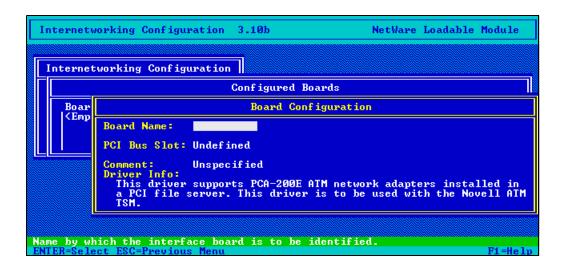


Figure 4.3 - Configuring Board Parameters

- 9. In the list of configuration parameters:
 - a. Configure a board name.
 - b. If you have installed more than one PCA-200EPC adapter, configure the slot number corresponding to the physical adapter that this driver will use.
- 10. Press the **<ESC>** key. A confirmation window appears.
- 11. Select Yes to confirm. The Configured Boards window appears with the new board and driver in the list, as shown in Figure 4.4.

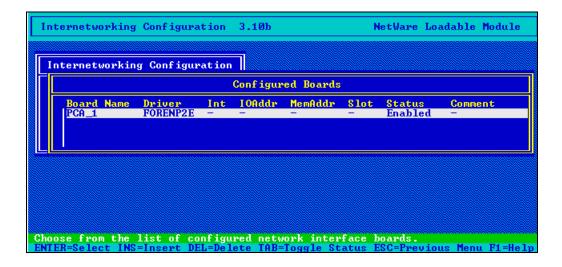


Figure 4.4 - Configured Boards Window

- 12. Repeat step 2 through step 11 for each FORENP2E driver you are installing.
- 13. Proceed to install the Novell LEC as described in "Step Three: Install and Configure the Novell LEC" on page 4-5.

4.1.2 Step Three: Install and Configure the Novell LEC

- 1. Install the Novell LEC files:
 - a. If you received the files in zipped form, you must unzip the files and copy them to a diskette with volume label ATM.



You must use label a:ATM.

b. Load the install utility with the following command:

LOAD INSTALL

- c. Select Product Options and then Install a product not listed.
- d. Insert the diskette containing the LEC files and press <ENTER>.
- e. Select Install Product and Select server.



For additional information on installing the Novell LEC, refer to the README file included with the Novell LEC files.

- 2. Load the INETCFG utility, and with the Configured Boards window showing, press the <Insert> key. A list of adapter drivers appears.
- 3. Select the appropriate LEC driver from the list:
 - ATMELEC for Ethernet LAN Emulation.
 - ATMTRLEC for Token Ring LAN Emulation.
- 4. In the list of configuration parameters, specify the ATM HSM Board Name of the PCA-200EPC adapter this LEC will be associated with. This name must match that specified when you configured the FORENP2E driver.
- 5. Specify an ELAN name and other parameters as desired. If you don't specify any parameters, the LEC will use values retrieved from the LECS.
- 6. Press the **<ESC>** key. A confirmation window appears.
- 7. Select Yes to confirm.
- 8. Repeat step 3 through step 7 for each LEC driver you are installing.
- 9. Press <ESC> to return to the Internetworking Configuration menu.

4.1.3 Step Four: Bind Protocols to the LEC Driver

- 1. Select Protocols in the options under Internetworking Configuration.
- 2. Enable IPX or TCP/IP
- 3. Press the **<ESC>** key. A confirmation window appears.
- 4. Select Yes to confirm.
- 5. Under Internetworking Configuration select Bindings.
- 6. Press the <Insert> key to bind the previously selected protocol.
- 7. Bind the protocol to the ATMELEC or ATMTRLEC driver, **not** the FORENP2E driver. Figure 4.5 shows the protocol being bound to the ATMELEC driver that was previously named LEC_1. The LEC is indicated as Ethernet or Token Ring media. The FORE HSM driver is indicated as FORENP2E media.

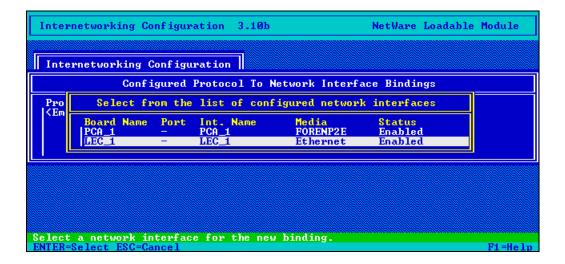


Figure 4.5 - Binding the Protocol to the Ethernet LEC

- 8. Press the **<ESC>** key. A confirmation window appears.
- 9. Select Yes to confirm.
- 10. Repeat this procedure for any additional LECs or protocols you are installing.
- 11. Press **<ESC>** to exit from the INETCFG utility. A confirmation window appears.
- 12. Select Yes to confirm.

4.1.4 Step Five: Re-Start the Server

Stop the server and then re-start it or issue the REINITIALIZE SYSTEM command to implement the changes. As the server starts up, the server displays the following messages:

```
Loading module FORENP2E.LAN
  ForeRunner PCA-200EPC ATM Adapter Driver
  Version 4.11
                 August 18, 1997
  Copyright (c) 1995 - 1997 FORE Systems, Inc., as an unpublished work. All righ
ts reserved
  Debug symbol information for FORENP2E.LAN loaded
FORENP2E: Using ForeRunner adapter in slot 0.
Loading module ATMELEC.LAN
  Novell ATM Ethernet LAN Emulation Client
 Version 1.01d January 27, 1997
  Copyright (C) 1995-1997 Novell, Inc. All rights reserved.
  Debug symbol information for ATMELEC.LAN loaded
 Loading module ATMELEC.LAN
 Loading module ATMELEC.LAN
 Previously loaded module was used re-entrantly
IPX LAN protocol bound to Novell ATM Ethernet LAN Emulation Client
IPX LAN protocol bound to Novell ATM Ethernet LAN Emulation Client
TCPIP-3.5-112: Bound to board 6 with IP address 169.100.10.242 and mask
  FF.FF.FF.O.
IP LAN protocol bound to Novell ATM Ethernet LAN Emulation Client
```

4.2 Manual Installation

This section contains procedures for copying the driver files to the SYS: SYSTEM directory and then manually editing the AUTOEXEC. NCF file to load the drivers when the server starts up.

4.2.1 Step One: Copy the Driver Files to SYS:SYSTEM

From a DOS or Windows NetWare attached client, copy the FORENP2E.LAN driver file from the \netware directory of the ForeRunner CD to the SYS:SYSTEM partition.

As described in the Novell LEC README file, install Novell's ATMELEC or ATMTRLEC files.

4.2.2 Step Two: Edit Your AUTOEXEC.NCF File

You must add load commands to your AUTOEXEC.NCF file to load the FORE HSM driver (FORENP2E.LAN) and Novell LEC (ATMELEC.LAN or ATMTRLEC.LAN). The FORENP2E driver must be loaded first, before the LEC drivers. You must also bind protocols to the LEC driver.

The FORENP2E.LAN file has the following load-time command line options:

SLOT=<n> Decimal integer used to select between multiple adapter cards. Required only when multiple adapters are used.

NAME=<identifier_string> A string. This name is used when binding ATMELEC or

ATMTRLEC drivers to the physical adapter. Optional, but simplifies LEC configuration by making it easier to

identify the ATM board.

ESI=<*n***>** Specifies ESI value for the cards MAC address. A 48 bit

HEX number. This is an optional parameter.

OC3=<SDH|SONET> (For OC3 adapters only). Indicates the physical framing

setting for the adapter. SDH indicates SDH physical framing. SONET indicates SONET physical framing. The

default is SONET. This is an optional parameter.

EMPTY= (For OC3 adapters only). Indicates how the driver **<IDLE|UNASSIGNED>** processes empty cells. IDLE indicates that empty cells

are transmitted as idle. UNASSIGNED indicates that empty cells are unassigned. The default transmission mode is SONET framing with unassigned empty cells.

This is an optional parameter.

None of these options are mandatory for a server with a single adapter card. For servers with multiple adapter cards, both the NAME and SLOT parameters are required for proper configuration.

The following is an example of a load command for a FORENP2E adapter:

LOAD FORENP2E NAME=ATM1 OC3=SDH



The LOAD command for the FORENP2E must appear before the LOAD commands for the ATMELEC or ATMTRLEC drivers.

Figure 4.6 shows sample lines for an AUTOEXEC.NCF file. These lines load one FORENP2E driver, and loads three ATMELEC drivers, and then binds protocols to each of the ATMELEC drivers.

Figure 4.7 shows sample lines for installing drivers for a server with two PCA-200EPC adapters. A single ATMELEC driver is then loaded for each adapter, and protocols are bound to the ATMELEC drivers.

```
# The following line loads the FORE FORENP2E driver.
load forenp2e name=adapter1
#
# The following three lines load instances of Novell's LEC code.
# Each of these commands binds the et1516 ELAN with a different frame type
# using the adapter named adapter1.
load atmelec ab=adapter1 elan="et1516" frame=ethernet_ii name=et1516_ii
load atmelec ab=adapter1 elan="et1516" frame=ethernet_802.3 name=et1516_8023
load atmelec ab=adapter1 elan="et1516" frame=ethernet_802.2 name=et1516_8022
#
#The following lines bind protocol stacks to the LEC drivers.
bind ipx et1516_8023 net=1517
bind ipx et1516_8022 net=1516
bind ip et1516_ii addr=169.100.10.242 mask=ff.ff.ff.00
```

Figure 4.6 - Sample AUTOEXEC . NCF File

```
load forenp2e name=b1 slot=0
load forenp2e name=b2 slot=1
load atmelec ab=b1 name=et1 elan="et4544" size=4544 frame=ethernet_802.2
bind ipx et1 net=4544
load atmelec ab=b2 name=et2 elan="et1516" frame=ethernet_802.2
bind ipx et2 net=1516
```

Figure 4.7 - Sample AUTOEXEC . NCF File for Multiple Adapters

4.2.3 Step Three: Re-Start the Server

Save the AUTOEXEC.NCF file and re-start the server. As the server starts up, you will see the following messages displayed momentarily on the screen:

```
Loading module FORENP2E.LAN
  ForeRunner PCA-200EPC ATM Adapter Driver
 Version 4.10 February 25, 1997
  Copyright (c) 1995 - 1997 FORE Systems, Inc., as an unpublished work. All righ
ts reserved
  Debug symbol information for FORENP2E.LAN loaded
FORENP2E: Using ForeRunner adapter in slot 0.
Loading module ATMELEC.LAN
  Novell ATM Ethernet LAN Emulation Client
 Version 1.01d January 27, 1997
 Copyright (C) 1995-1997 Novell, Inc. All rights reserved.
 Debug symbol information for ATMELEC.LAN loaded
Loading module ATMELEC.LAN
Loading module ATMELEC.LAN
  Previously loaded module was used re-entrantly
IPX LAN protocol bound to Novell ATM Ethernet LAN Emulation Client
IPX LAN protocol bound to Novell ATM Ethernet LAN Emulation Client
TCPIP-3.5-112: Bound to board 6 with IP address 169.100.10.242 and mask
  FF.FF.FF.O.
IP LAN protocol bound to Novell ATM Ethernet LAN Emulation Client
```

4.3 Viewing ATM Driver Status and Statistics

4.3.1 ATMELEC and ATMTRLEC Status

To view the status of the Ethernet LEC, use the following command:

LOAD ATMELEC STATUS

To view the status of the Token Ring LEC, use the following command:

LOAD ATMTRLEC STATUS

This command displays information similar to the following:

4.3.2 FORENP2E Status

You can also use the MONITOR module to view statistics for the physical ATM adapter. Use the following command:

LOAD MONITOR

- 1. Select LAN/WAN information from the Available Options menu.
- 2. Select the FORENP2E driver for which you want to display statistics.

- 3. A wide variety of information is displayed:
 - Generic statistics, including packets sent and received.
 - Speed of the adapter.
 - Maximum number of VCs supported by the adapter.
 - Maximum AAL5 frame size supported by the adapter.
 - Number of signalling restarts performed by the adapter.
 - Number of addresses registered by the adapter.
 - Total number of connections maintained by the adapter.
 - Connection Manager statistics.
 - Signalling statistics.
 - Quality of Service statistics.
 - ILMI statistics.
 - Common and custom HSM statistics.
 - Carrier status.

A portion of the monitor statistics are shown in Figure 4.8.

```
NetWare 4.x Console Monitor 4.34
Server name: 'SB8' in Directory tree 'FORE'
Server version: NetWare 4.11 - August 22, 1996

PCA1 IFORENP2E mem=C3E00000 mem=C3F00000 int=B frame=atm]

Uersion 1.0
Node address: 00204808095C
Protocols:

Generic statistics
Total packets sent:
Total packets received:
No ECB available count:

Custom statistics
Speed of Interface (Kbps):
Maximum Number of UCs Supported:
Maximum AAL5 Frame Size Supported:
Number of Signaling Link (Re)Starts:
Number of Addresses Registered:
Total Number of Connections:
Total Previous list Alexand Exit
```

Figure 4.8 - FORENP2E Monitor Statistics (Partial)

CHAPTER 5

Windows NT Installation

This chapter describes how to install the FORE ATM drivers on a Windows NT operating system and gives requirements for the FORE drivers. Procedures for Windows NT 3.51 and 4.0 are given. The installation process copies the drivers from the *ForeThought* software CD to the \%system-root%\drivers directory (usually \system32\drivers). The installation process also copies the FORE Systems statistics application, InFOREmation Center (described in Chapter 7) to the \%system-root% directory (usually \system32).

5.1 Procedures for all FORE PC Adapters

These procedures can be used to install the Windows NT drivers for any of the FORE PC adapters:

- ForeRunnerLE, also referred to as the LE adapter
- PCA-200EPC, also referred to as the PCA adapter

In the examples throughout the chapter, the examples show the installation of the driver for an *LE* adapter. During the installation, the model name for your adapter will appear in the dialog boxes relating to the ATM adapter driver.

5.2 The FORE ATM and LANE Drivers

You must install both a FORE ATM driver and one or more of the following FORE drivers:

- Emulated LAN (ELAN) driver to connect to an emulated LAN.
- IP over ATM (RFC 1577) (also referred to as Classical IP or CLIP) driver to connect to a CLIP Logical IP Subnet (LIS).

Contact your system administrator for information about the drivers you must install. An introduction to LAN Emulation and Classical IP is given in Chapter 1.



You must install the *ForeRunner* PCA or *ForeRunnerLE* ATM Adapter driver prior to installing the ELAN or IP over ATM driver or drivers.

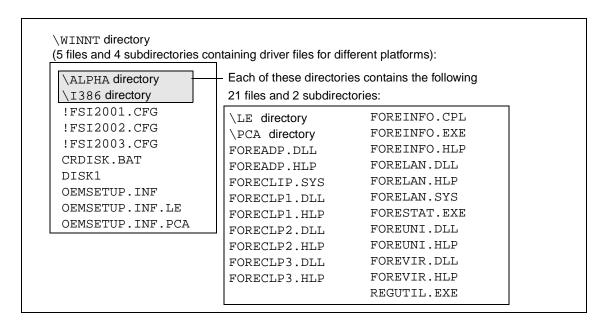


Figure 5.1 - Relevant Files Included on the *ForeThought* Software CD

5.3 Installation Requirements

Requirements to ensure proper installation of the FORE ATM drivers are:

- Approximately 1 MB of free disk space in the installation directory file system
- 16 MB of RAM minimum
- Microsoft Windows NT version 4.0 or 3.51, server or workstation
- A PCI 2.0/2.1 compliant PC that appears on the Microsoft, Inc., Hardware Compatibility List
- Successful installation of the LE or PCA adapter card
- Correct configuration of the PCI slot (see Chapter 2)
- ForeThought software CD

5.3.1 Relevant Files

The relevant files are in the \WINNT directory of the *ForeThought* software CD. Within the directory are the files listed in Figure 5.1. The files on the CD are compressed, and are uncompressed in the installation process. Do not copy the files and attempt to execute them directly.

5.4 Installing the FORE Adapter Software

The installation of the FORE ATM adapter software consists of three parts:

- 1. Installing the *ForeRunner* ATM Adapter driver for each FORE adapter that has been installed on your PC.
- 2. Installing and configuring one or more of the following:
 - A ForeRunner ELAN Adapter driver for each ELAN to which you want to connect.
 - b. A *ForeRunner* IP over ATM (RFC 1577) Adapter driver for each Classical IP LIS to which you want to connect.
- 3. Bind your network protocols to the ELAN or IP Over ATM drivers.

The following sections describe these procedures.

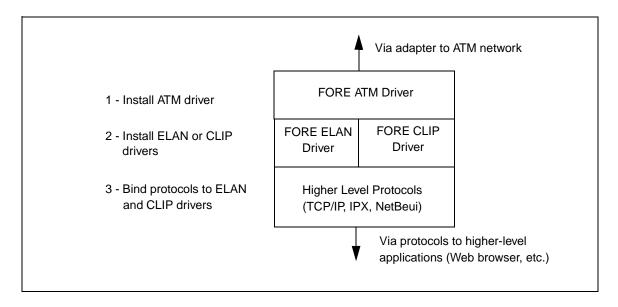


Figure 5.2 - FORE Driver Configuration

5.4.1 Installing Drivers While Installing NT 4.0 Networking

If Windows NT 4.0 networking has **not** been installed, use the following procedure to install the FORE drivers at the same time you install the Windows NT 4.0 networking component. This procedure involves using the Networking Wizard and installing Windows NT 4.0 networking files.



This procedure requires your Microsoft Windows NT 4.0 Installation CD.

- 1. Display the Network control panel by using the following procedure:
 - Choose the Start button on the Taskbar.
 - b. Choose Settings.
 - c. Choose Control Panel. The Control Panel appears.
 - d. Double-click on the Network icon.

The prompt shown in Figure 5.3 appears, asking if you want to install Windows NT networking. Select Yes.

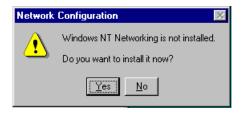


Figure 5.3 - Windows NT Prompt

- 2. The Network Setup Wizard appears.
- 3. Select **Next** to continue. The Adapter Search dialog box of the Wizard appears, as shown in Figure 5.4.

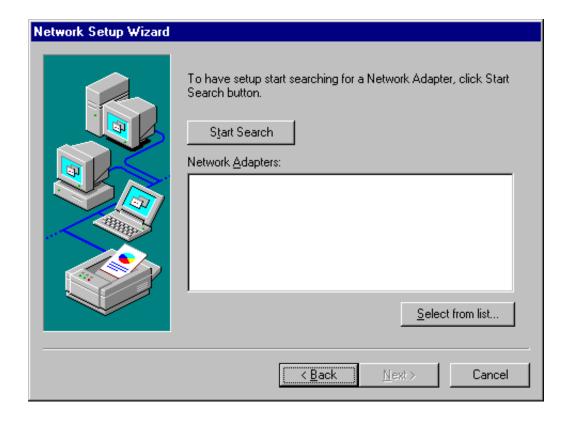


Figure 5.4 - Network Setup Wizard, Adapter Search

- 4. Choose Select from list.... The Select Network Adapter dialog box is displayed.
- 5. Choose the Have Disk... button. The Insert Disk dialog box appears.
- 6. Insert the *ForeThought* software CD in the CD-ROM drive and change the path to indicate **D:\WINNT**, where **D:** indicates your CD-ROM drive.
- 7. Press <ENTER>. The Select OEM Option dialog box appears.
- 8. Select the ForeRunner (xxx) ATM driver that matches your adapter (PCA or LE) and choose OK. The driver appears in the Network Adapters list.
- 9. Return to step 4 and repeat the process to install one or more ELAN or IP Over ATM drivers.
- 10. Choose Next to proceed. The Network Wizard Protocols dialog box appears.
- 11. Check any protocols required for your machine in addition to TCP/IP.

- 12. Choose **Next** to proceed. The Network Wizard Network Services dialog box appears. Add additional services if it is necessary for your installation.
- 13. Choose Next to proceed. The Network Wizard displays informational text.
- 14. Choose **Next** to proceed. The Network Wizard prompts you for the Windows NT files, as shown in Figure 5.5.

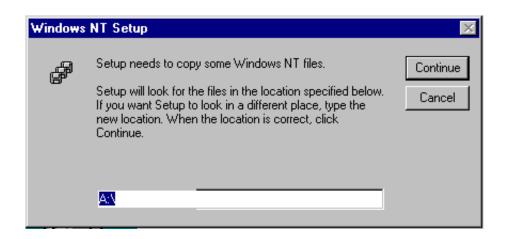


Figure 5.5 - Prompt for Windows NT Files

15. Although the prompt indicates that Setup needs Windows NT files, it actually needs the FORE driver files. Change the path to d:\winnt (where D: is your CD-ROM drive). Choose Continue. A second prompt appears, identical to that shown in Figure 5.5.

16. Setup now needs the Windows NT networking files. Remove the *ForeRunner* CD and replace it with the Windows NT distribution CD. Specify the directory containing the Windows NT distribution files and choose Continue. The Windows NT Setup dialog box appears as files are copied.



Be sure to change the path when you replace the *ForeRunner* CD with the Windows NT distribution CD.

Incorrectly specifying the path (for example, specifying the path D:\winnt, used for the FORE driver files, when the Windows NT CD is in the drive) will cause errors as Setup attempts to install the files.

- 17. The ForeRunner (xxx) ATM Driver dialog box appears. Edit the parameters as described in "Installing the FORE ATM Adapter Driver" on page 5-9. Choose OK when you are done editing the dialog box.
- 18. Additional dialog boxes for the ELAN and IP Over ATM drivers appear. Edit them as described in "Installing the Emulated LAN Adapter Driver" on page 5-17 and "Installing the IP Over ATM (Classical IP) Adapter Driver" on page 5-23. The default settings are adequate for most sites. If installing the IP Over ATM driver, you must specify the ATM address of the ARP server.
- 19. Windows NT continues to install the networking components it needs. Depending on what Windows NT files have already been installed, a prompt may appear, asking you to insert the Microsoft Windows NT 4.0 software CD. Insert the CD and proceed.
- 20. As Windows NT installs the network bindings, it prompts you for TCP/IP bindings for the ELAN or IP Over ATM drivers. Specify the TCP/IP addresses for each driver and proceed.
- 21. When the final dialog box of the Network Wizard appears, choose Finish. A prompt appears, asking you to reboot the system.
- 22. Choose Yes.

Installation of the drivers is now complete.

5.4.2 Installing the FORE ATM Adapter Driver

Use the following procedure to install the FORE ATM Adapter driver on a Windows NT version 3.51 or 4.0 system. When installing on a Windows NT 3.51 system, the dialog boxes appear slightly different than those shown here.



If you are installing the drivers on a Windows NT 4.0 system that does not have the networking components installed, use the procedure in "Installing Drivers While Installing NT 4.0 Networking" on page 5-5.

- 1. Log on to the PC. You must have administrative privileges.
- 2. Display the Network control panel (shown in Figure 5.6) by using the following procedure:
 - a. Choose the Start button on the Taskbar.
 - b. Choose Settings.
 - c. Choose Control Panel. The Control Panel appears.
 - d. Double-click on the Network icon.

The Network control panel appears.

For Windows 3.51 - Open the Control Panel and double-click on the Network icon.

3. Choose the Adapters tab and choose Add.... The Select Network Adapter dialog box appears (see Figure 5.7).

For Windows 3.51 - Choose the Add Adapter button. The Add Network Adapter dialog box appears.

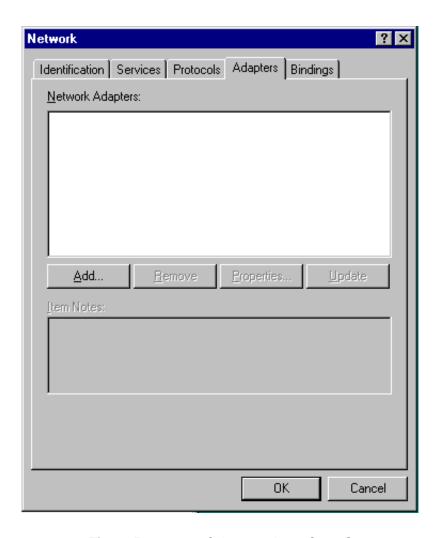


Figure 5.6 - Network Settings Control Panel

4. Select ${\tt Have\ Disk...}$ The Insert ${\tt Disk\ dialog\ box\ appears}.$

For Windows 3.51 - Select <Other> Requires disk from manufacturer in the Network Adapter Card field. Then, choose the Continue button.



Figure 5.7 - Select Network Adapter Dialog Box

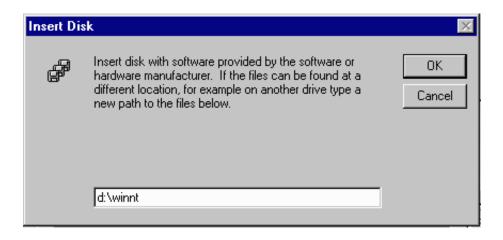


Figure 5.8 - Insert Disk Dialog Box

- 5. Insert the *ForeThought* software CD into the CD-ROM drive and change the default drive specification to indicate **D:\WINNT**, as shown in Figure 5.8. **D:** indicates your CD-ROM drive.
- 6. Choose the **OK** button. The Select OEM Option dialog box appears, as shown in Figure 5.9).

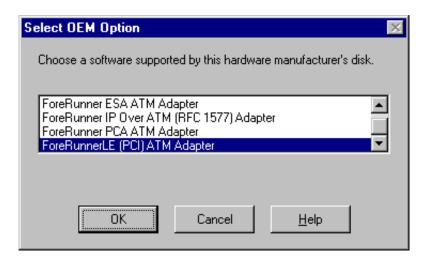


Figure 5.9 - Select OEM Option Dialog Box

- 7. Select the appropriate ATM driver for your adapter. In this example, ForeRunnerLE (PCI) ATM Adapter is selected. Choose the OK button.
- 8. The ForeRunner (xxx) ATM Adapter dialog box appears (see Figure 5.10) after the files are copied. You can choose Cancel to abort the entire installation process. Modify the fields to conform to your system requirements (the default values are adequate for most installations).

If your site is using ILMI - If you are using ILMI to determine the hosts ATM address and UNI version, and are using the default buffer values and other defaults, you can immediately choose the OK button and proceed to step 14 on page 5-15.

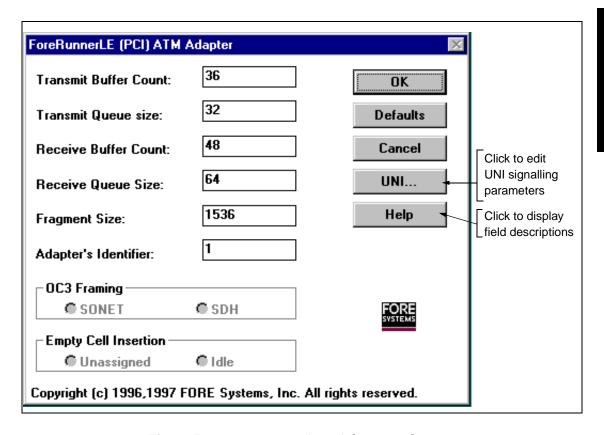


Figure 5.10 - ForeRunner ATM Adapter Dialog Box

If you have installed multiple adapters - Note the number in the Adapter's Identifier field for this adapter. You need this information when defining the ForeRunner ELAN or IP Over ATM driver or drivers associated with this adapter.



Any changes to values appearing in this dialog box take effect only when the system is rebooted.

9. If you are not using ILMI or must edit the UNI signalling parameters for this adapter, choose the UNI... button.

Otherwise, choose the OK button when you are done editing the parameters and proceed to step 13.

10. If you selected the UNI... button, the ATM UNI Signalling Configuration dialog box appears (see Figure 5.11). By default, ILMI Enabled is selected and you cannot modify the local ATM address of the adapter. Select the Disabled radio button if you want to manually enter the local ATM address of the adapter.

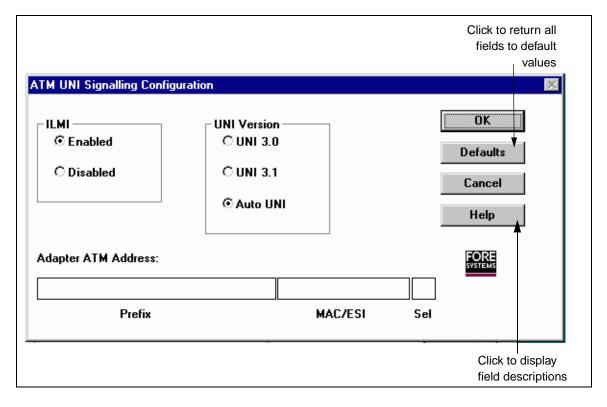


Figure 5.11 - ATM UNI Signalling Configuration Dialog Box



If you disable ILMI and the UNI Version parameter was set to Auto UNI, the UNI Version reverts to UNI 3.0 (because the driver can no longer use ILMI to determine the UNI version). You *must* use the same version of UNI as that used by the ATM switch to which the adapter is connected. Get the correct values from your system administrator.

If you don't know the MAC address - If you aren't using ILMI and don't know the MAC address, you can specify mm for each two-byte portion of the MAC/ESI address. The adapter then automatically provides the address when it starts up.

Refer to "How to Specify an ATM Address" on page 3-4 for information about the format of an ATM address.

- 11. Choose the OK button to return to the ForeRunner ATM Adapter dialog box.
- 12. Choose the OK button.
- 13. A warning message appears, explaining that you must install the ELAN or IP Over ATM adapter driver. Choose the OK button to continue.
- 14. The Network Settings control panel appears with the ForeRunner (adapter-model) ATM Adapter driver in the list of Installed Adapter Cards, as shown in Figure 5.12.

For Windows NT 3.51 - The ForeRunner (adapter-model) ATM Adapter appears in the Installed Adapter Cards list and ForeRunner (adapter-model) ATM Adapter Driver appears in the Installed Network Software list.

- 15. Proceed to do either or both of the following:
 - a. Install one or more *ForeRunner* Emulated LAN Adapter drivers using the procedure in "Installing the Emulated LAN Adapter Driver" on page 5-17.
 - b. Install one or more *ForeRunner* IP Over ATM Adapter drivers using the procedure in "Installing the IP Over ATM (Classical IP) Adapter Driver" on page 5-23.

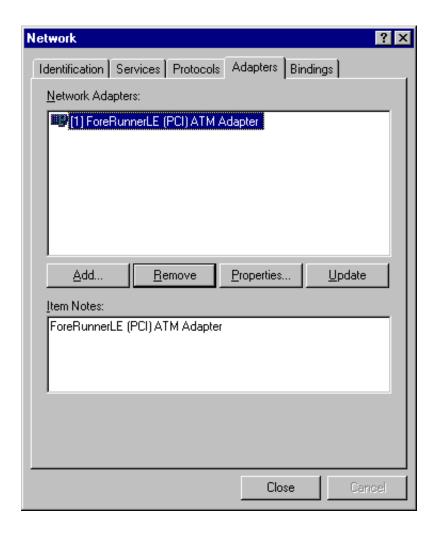


Figure 5.12 - Network Control Panel with ATM Driver Installed

5.4.3 Installing the Emulated LAN Adapter Driver

5.4.3.1 Connecting to Multiple ELANs

You may want to join more than one ELAN, for example, Engineering and Marketing. If so, then the following procedure must be repeated once for each ELAN that you want to join. You can connect to a combined total of 16 ELANs and LISs.

5.4.3.2 Installing the ELAN Driver

Use the following procedure to install the *ForeRunner* Emulated LAN Adapter driver on an existing Windows NT system:

- Choose the Adapter tab and choose Add. The Select Network Adapter dialog box appears.
 - For Windows 3.51 Choose the Add Adapter button. The Add Network Adapter dialog box appears.
- 2. Select Have Disk.... The Insert Disk dialog box appears.
 - For Windows 3.51 Select <Other> Requires disk from manufacturer in the Network Adapter Card field. Then, choose the Continue button.
- 3. Insert the *ForeThought* software CD into the CD-ROM drive and change the drive specification to indicate **D:\WINNT**, where **D:** indicates your CD-ROM drive.
- 4. Choose the OK button. The Select OEM Option dialog box appears, as shown previously in Figure 5.9.
- 5. Select ForeRunner ATM ELAN Adapter and choose the OK button. The Windows NT Set-Up dialog box with a progress bar appears and the required files are copied from the CD.
- 6. The ForeRunner Emulated LAN Adapter dialog box appears (see Figure 5.13) after the files are copied.

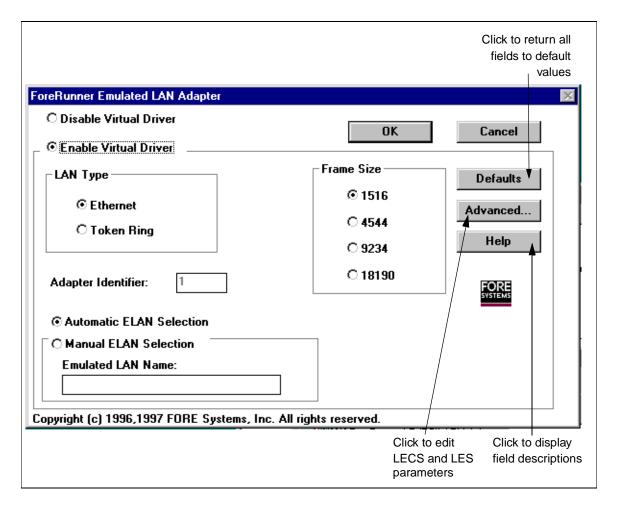


Figure 5.13 - Emulated LAN Adapter Dialog Box

If your site is using the LECS - If you are using the LECS and other default values (LECS autodiscovery, automatic ELAN selection, Ethernet LAN Type with a Frame Size of 1516), you can choose the OK button and proceed immediately to step 8 on page 5-21.

Otherwise, edit the parameters as needed:

a. If you want to disable this driver, so it does not start when the system is rebooted, select Disable Virtual Driver. When this option is selected, all parameters for the driver are grayed out and cannot be edited.

- b. Select the media type of the ELAN to which this driver connects, either Ethernet or Token Ring.
- c. Select the appropriate Frame Size. This value must match the frame size of other hosts on the ELAN.
- d. If you have more than one FORE adapter in your system, and you want to associate this ELAN with an adapter other than the first, you must specify a value in the Adapter Identifier box. This field is read-only if only one FORE ATM adapter is installed in your system.
 - The adapter identifier for each adapter was assigned in step 8 on page 5-12 of the previous procedure.
- e. If you are using an LECS, you can choose Automatic ELAN Selection in order to use the default ELAN specified by the LECS. In this case you don't need to enter a value in the Emulated LAN Name field, and can proceed to step 8.
- f. Enter the Emulated LAN Name that you want to join. Any valid alphanumeric name up to 32 characters long may be specified.

Specifying a LES failover sequence - If the LECS has been configured to support failovers in the event of the failure of a LES, you can specify a failover sequence when you specify the ELAN name. To do this, specify the ELAN name, a vertical bar, and a range corresponding to the backup ELANs you want this LEC to contact if one or more LES's fail. For example, if the ELAN name is production, and a total of five ELANs for production have been configured, and you want to attempt each of the five in the event of multiple LES failures, specify the following in the Emulated LAN Name field:

production | 1-5



If the Automatic ELAN Name feature has been configured on the LECS (and you are using the LECS), you do not have to specify an ELAN name. The host will join the ELAN indicated by the LECS. You must still specify the ELAN type and MTU size (or accept the default). If no ELAN has been specified on the LECS that matches these parameters, the Automatic ELAN Name feature will not work. Use the InFOREmation Center utility, described in Chapter 7, to determine the name of the ELAN that the driver has joined.

This feature can only be used on one ELAN driver. For all other ELAN drivers, you must specify the ELAN name.

- g. If you must configure the ATM address of the LECS or LES, choose the Advanced button.
- h. If you do not need to configure the advanced parameters, proceed to step 8.
- 7. If you chose the Advanced button, the ATM Forum LAN Emulation Configuration dialog box appears (see Figure 5.14). By default, the Yes radio button in the Use LECS box and the Enabled radio button in the Discover LECS box are selected.

If you aren't using the LECS - Under Use LECS select the No option. You must then specify the LES address in the LES ATM Address field.

If you aren't using auto-discovery for the LECS - Under Discover LECS select the Disabled option and enter the LECS address in the LECS ATM Address field.

Refer to "How to Specify an ATM Address" on page 3-4 for information about the format of an ATM address.

Choose OK when you are done editing the fields on this dialog box. The ForeRunner Emulated LAN Adapter dialog box reappears.

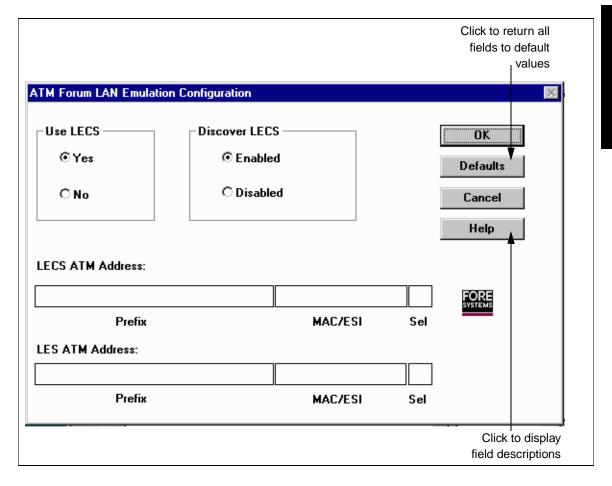


Figure 5.14 - ATM Forum LAN Emulation Configuration Dialog Box

8. Choose OK when you are finished configuring the *ForeRunner* ELAN adapter driver. If you are using the Automatic ELAN Selection feature, a warning appears, indicating that you must be careful when setting the TCP/IP address for the ELAN driver. Choose OK.

The Network Settings Control Panel appears, with the ForeRunner ELAN Adapter driver in the list of Installed Adapter Cards, including the unit number. A description of the adapter appears in the Description field. Figure 5.15 shows an example of the Network Settings control panel with the FORE ATM driver and an ELAN drivers installed. The name of the ELAN associated with each ELAN driver appear in parentheses.

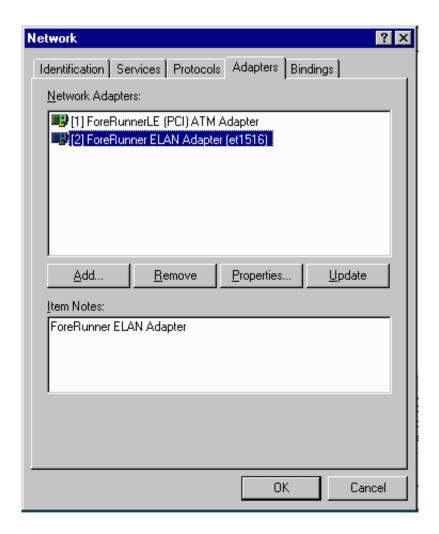


Figure 5.15 - Network Settings with ELAN Driver Installed

9. Do one of the following:

- Return to the beginning of this procedure to install additional ELAN drivers.
- b. Proceed to "Installing the IP Over ATM (Classical IP) Adapter Driver" on page 5-23 to install one or more Classical IP drivers.
- c. Proceed to "Binding Protocols to the ELAN and IP Over ATM Drivers" on page 5-29 if you have installed all ELAN and IP over ATM drivers.

5.4.4 Installing the IP Over ATM (Classical IP) Adapter Driver

5.4.4.1 Connecting to Multiple LISs

You may want to join more than one LIS, for example, Engineering and Marketing. If so, then the following procedure must be repeated once for each LIS that you want to join. You can connect to a combined total of 16 ELANs and LISs.

5.4.4.2 Installing the IP Over ATM Driver

Use the following procedure to install the *ForeRunner* IP Over ATM Adapter driver on an existing Windows NT system:

- Choose the Adapter tab and choose Add. The Select Network Adapter dialog box appears.
 - For Windows 3.51 Choose the Add Adapter button. The Add Network Adapter dialog box appears.
- 2. Select Have Disk... The Insert Disk dialog box appears.
 - For Windows 3.51 Select <Other> Requires disk from manufacturer in the Network Adapter Card field. Then, choose the Continue button.
- 3. Insert the *ForeThought* software CD into the CD-ROM drive and change the drive specification to indicate **D:\WINNT**, where **D:** indicates your CD-ROM drive.
- 4. Choose the OK button. The Select OEM Option dialog box appears.
- 5. Select ForeRunner IP Over ATM (RFC 1577) Adapter and choose the OK button. The Windows NT Set-Up dialog box with a progress bar appears and the required files are copied from the CD.
- 6. The IP Over ATM Adapter Configuration dialog box appears (see Figure 5.16) after the files are copied.

7. Edit the Adapter Configuration dialog box as necessary for your site You can accept defaults for all parameters except the ARP Server ATM Address field.

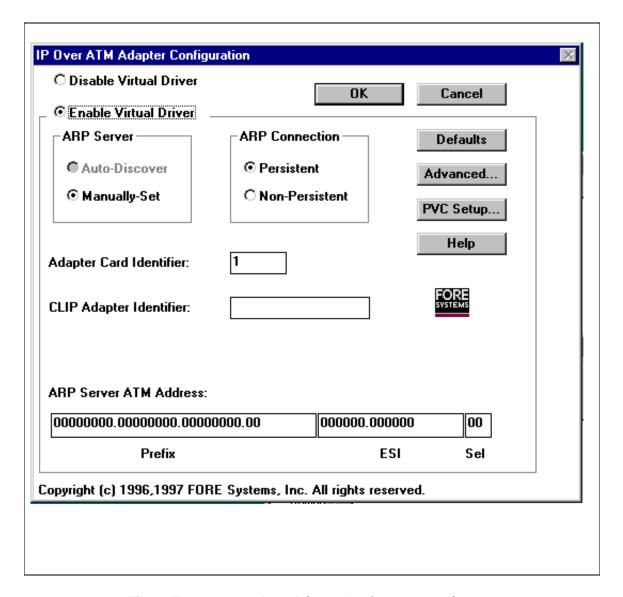


Figure 5.16 - IP Over ATM Adapter Configuration Dialog Box

- a. If you want to disable this driver, so it does not start when the system is rebooted, select Disable Virtual Driver. When this option is selected, all parameters for the driver are grayed out and cannot be edited.
- b. Select whether you want the connection to the ARP Server to be Persistent, in which the connection is maintained continuously, or Non-Persistent, in which the connection is created only when needed.
- c. If you have more than one FORE adapter in your system, and you want to associate this ELAN with an adapter other than the first, you must specify a value in the Adapter Card Identifier box. This field is read-only if only one FORE ATM adapter is installed in your system.
 - The adapter identifier for each adapter was assigned in step 8 on page 5-12 of the previous procedure.
- d. In the CLIP Adapter Identifier field you can assign a name or number to this driver. The name can contain any valid alphanumeric character and be up to 32 characters long.
- e. You *must* specify the ATM address of the ARP Server that this driver uses to resolve addresses of other hosts. Get this address from your system administrator. For other parameters you can use the defaults unless directed otherwise by your system administrator.
- f. If you must configure the MTU size (the default is set to 9180, the recommended size for Classical IP LIS's) or change the default values for time-out parameters (how long entries are kept in the ARP cache, how long before the idle connections are dropped, etc.), choose the Advanced button.
- g. If you must manually configure PVC connections to other hosts on the LIS, choose the PVC Setup button.
- h. If you do not need to configure the advanced parameters or PVCs, proceed to step 8.

8. If you chose the **Advanced** button, the IP Over ATM Adapter Configuration Parameters dialog box appears, as shown in Figure 5.17. Edit the configuration parameters as necessary for your site.

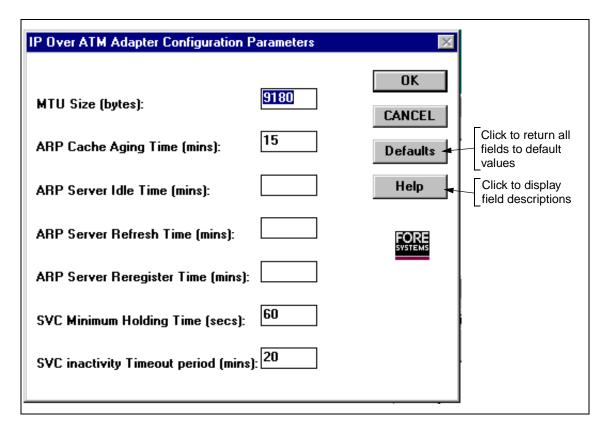


Figure 5.17 - IP Over ATM Adapter Configuration Parameters Tab

9. If you must manually enter PVC connections for the driver, choose the PVC Setup... button. The IP Over ATM Adapter PVC Connections dialog box is displayed, as shown in Figure 5.18. Contact your system administrator for any PVCs you may have to add.

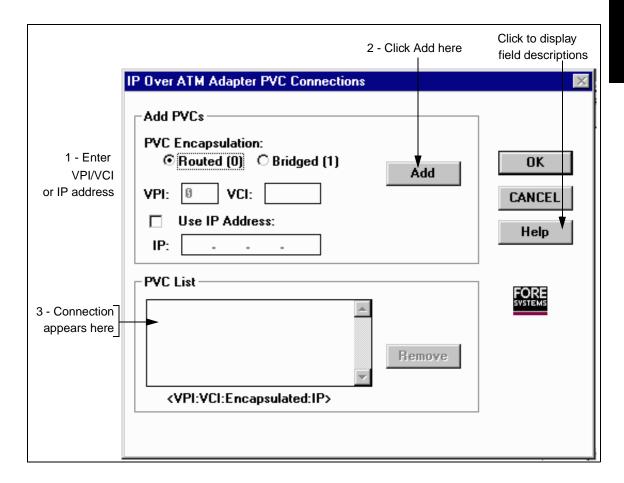


Figure 5.18 - IP Over ATM Adapter PVC Connections Dialog Box

- a. Enter the VCI for the PVC connection (the VPI is always zero) or check the Use IP Address option and specify the IP address of the destination host. Only VPI 0 is supported. Also, please note that VCI's 0 through 31 are reserved by the ATM Forum, and that the FORE drivers support a limit of 1024 VCI's.
- b. You can accept the default encapsulation (Routed). Bridged encapsulation is not available in this release.

c. Choose the Add button. The connection appears in the PVC List. Repeat these steps for additional PVC connections.

Removing Connections from the List - To remove a connection from the list, highlight the connection by clicking on it in the list and choose the Remove button.

10. Choose OK to return to the IP Over ATM Adapter Configuration dialog box. Choose OK again. The Network control panel appears with the IP Over ATM driver in the Network Adapters list, as shown in Figure 5.19.

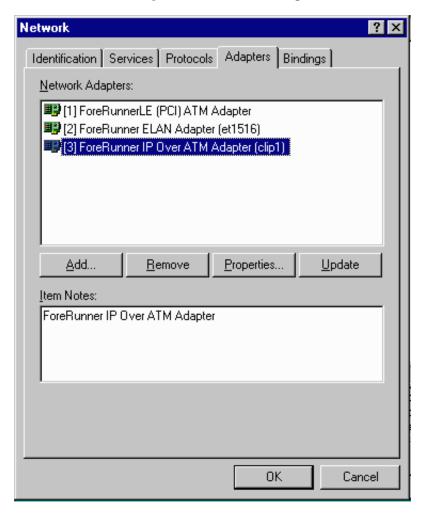


Figure 5.19 - Network Control Panel with IP Over ATM Driver Installed

- 11. Do one of the following:
 - Return to the beginning of this procedure to install additional IP Over ATM (RFC 1577) drivers.
 - b. Proceed to "Binding Protocols to the ELAN and IP Over ATM Drivers" on page 5-29 if you have installed all ELAN and IP over ATM drivers.

5.4.5 Binding Protocols to the ELAN and IP Over ATM Drivers

Use the following procedure to complete the installation:

- 1. After installing all ELAN and IP Over ATM drivers, choose Close in the Network control panel to complete the installation. Progress bars are displayed.
- 2. Additional dialog boxes appear, depending on the installed network software. The dialog boxes may be different than those shown in the following steps.



The IP Over ATM driver only binds to TCP/IP. The ELAN driver can bind to TCP/IP, NetBeui, or IPX/SPX.

- 3. The TCP/IP Configuration dialog box appears (see Figure 5.20) if TCP/IP network software is installed. If not, skip ahead to step 8.
- 4. In the TCP/IP Configuration dialog box, select the IP Address tab, scroll through the Adapter card list, and select the FORE ELAN and IP Over ATM drivers. If you have multiple adapters installed, the adapter identifier number is included in the brackets adjacent to the adapter name (it is shown as 5 in Figure 5.20). This identifier was assigned to the adapter in step 7 of the previous procedure, "Installing the FORE ATM Adapter Driver" on page 5-9.

For Windows 3.51 - You don't have to select the IP Address tab.



If you are using automatic ELAN selection and TCP/IP, you must still get the appropriate TCP/IP address for your host on that ELAN.

5. Fill in the appropriate fields for *each* ELAN or IP Over ATM driver with your particular network parameters. For specific instructions about Windows NT network configuration, please consult your system administrator and the appropriate Windows NT documentation.

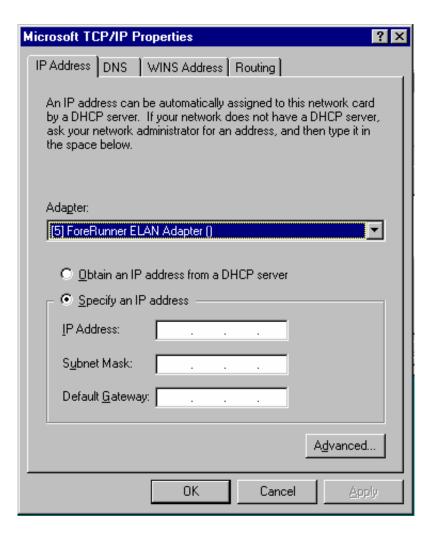


Figure 5.20 - TCP/IP Configuration

- 6. In the TCP/IP Configuration dialog box, choose the DNS tab. (DNS is the Domain Name Server).
 - **For Windows 3.51** Choose the DNS button. The DNS Configuration dialog box appears.
- 7. Fill in the parameters appropriate for your network configuration. For specific instructions on Windows NT network configuration, please consult your system administrator and the appropriate Windows NT documentation. When finished, choose the OK button.
- 8. If you do not have Novell NetWare access software installed, or have only installed the IP Over ATM driver skip ahead to step 9.
 - If the network software for accessing Novell NetWare is installed on your PC, a dialog box similar to that shown in Figure 5.21 appears. Auto Detect is the default option for Frame Type and is acceptable for ELAN adapter driver configuration. Choose OK. The Network control panel appears.

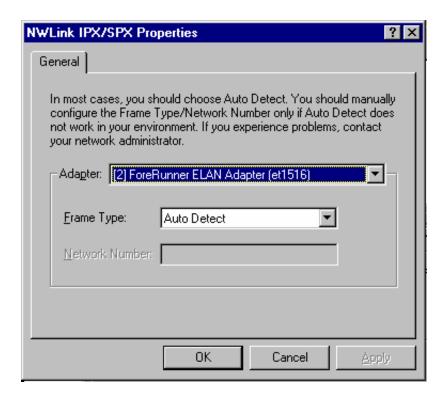


Figure 5.21 - IPX Protocol Configuration

9. Choose the OK button on the Network control panel. The Network Settings Change message appears, asking if you want to restart the PC so the latest changes can take effect.

Choose the Yes button. The *ForeRunner* adapter driver installation is now complete. When the PC reboots, the FORE ATM, ELAN, and IP Over ATM drivers are loaded.

5.5 Upgrading the FORE Adapter Software

Upgrading the FORE ATM adapter software consists of the following steps:

- 1. Upgrade the driver software:
 - a. FORE ATM Adapter driver software for your adapter.
 - b. Upgrade the ForeRunner ELAN Adapter driver software.
 - c. Upgrade the *ForeRunner* IP over ATM driver software.
- 2. Configure the drivers:
 - a. Configure the FORE ATM Adapter driver for each adapter card, if necessary.
 - b. Configure the *ForeRunner* ELAN Adapter driver for each ELAN, if necessary.
 - c. Configure the *ForeRunner* IP Over ATM Adapter driver for each ELAN, if necessary.

To perform these steps, use the following procedures.

5.5.1 Upgrading the Driver Software

To upgrade existing driver software from the *ForeThought* software CD, use the following procedure:

- 1. Log on to the PC. You must have administrative privileges.
- 2. Display the Network control panel (shown in Figure 5.22) by using the following procedure:
 - a. Choose the Start button on the Taskbar.
 - b. Choose Settings.
 - c. Choose Control Panel. The Control Panel appears.
 - d. Double-click on the Network icon.

The Network Settings control panel appears.

For Windows 3.51 - Open the Control Panel and double-click on the Network icon.

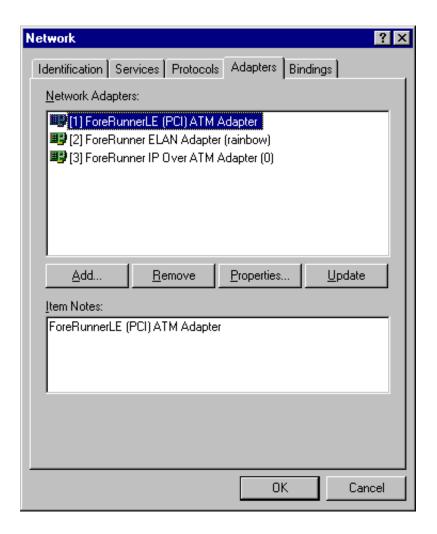


Figure 5.22 - Network Control Panel - Adapters Tab

3. Select the Adapters tab and select the ForeRunner adapter-model ATM Adapter in the Network Adapters list. adapter-model indicates your adapter model, ForeRunnerLE or PCA.

For Windows NT 3.51 - In the Installed Network Software list, select the software for your adapter, either ForeRunnerLE (PCI) ATM Adapter Driver or ForeRunner PCA ATM Adapter Driver.

- 4. Choose the **Update** button. The Windows NT Setup dialog box is displayed, asking you to specify the path for the update file.
- 5. Insert the *ForeThought* software CD into the CD-ROM drive and change the drive specification to indicate D:\WINNT, where D:\ indicates your CD-ROM drive. Choose Continue.
 - The Windows NT Set-Up dialog box with a progress bar appears and the required files are copied from the CD.
- 6. Repeat step 3 through step 5 to upgrade the software for each ForeRunner Emulated LAN Adapter in the list.
 - For Windows NT 3.51 Repeat step 3 through step 5. In the Installed Network Software list, select ForeRunner Emulated LAN Adapter Driver.
- 7. Repeat step 3 through step 5 to upgrade the software for each ForeRunner IP Over ATM Adapter in the list.

For Windows NT 3.51 - Repeat step 3 through step 5. In the Installed Network Software list, select ForeRunner IP Over ATM (RFC 1577) Adapter Driver.

5.5.2 Configuring the Drivers

If you must configure drivers that have already been installed, use the following procedure:

- 1. Log in as administrator.
- 2. Display the Network control panel (shown in Figure 5.22) by using the following procedure:
 - a. Choose the Start button on the Taskbar.
 - b. Choose Settings.
 - c. Choose Control Panel. The Control Panel appears.
 - d. Double-click on the Network icon.

The Network Settings control panel appears.

For Windows 3.51 - Open the Control Panel and double-click on the Network icon.

- 3. Select the ForeRunner (xxx) ATM Adapter in the Installed Adapter Cards list.
- 4. Choose the **Properties** button.

For Windows 3.51 - Choose the Configure button.

5. Proceed to configure the parameters for the FORE ATM adapter driver as described in step 8 on page 5-12 through step 14 on page 5-15. Repeat these steps

- for each LE or PCA adapter you are configuring.
- 6. To configure the ELAN parameters, select the ForeRunner ELAN ATM Adapter that you want to configure in the Network Adapters list.
- 7. Choose the Properties button.
 - For Windows 3.51 Choose the Configure button.
- 8. Proceed to configure the parameters for the ELAN adapter driver as described in step 6 of "Installing the Emulated LAN Adapter Driver" on page 5-17. Repeat this step for each ELAN driver you are configuring.
- 9. To configure the IP Over ATM parameters, select the ForeRunner IP Over ATM Adapter that you want to configure in the Network Adapters list.
- 10. Choose the Properties button.
 - For Windows 3.51 Choose the Configure button.
- 11. Proceed to configure the parameters for the IP Over ATM adapter driver as described in step 7 of "Installing the IP Over ATM (Classical IP) Adapter Driver" on page 5-23. Repeat this step for each ELAN driver you are configuring.
- 12. When you have finished configuring the *ForeRunner* ATM adapters and *ForeRunner* ELAN adapter drivers, choose OK on the Network Settings dialog box. The Network Settings Change message appears, asking if you want to restart the PC so the latest changes can take effect.
- 13. Choose the Restart Now button. The *ForeRunner* ATM adapter driver installation is now complete. When the PC reboots, the changes to the and ELAN drivers take effect.

The upgrade is complete.

5.6 Screen Savers and Network Performance

Some Windows screen savers use a substantial percentage of the CPU utilization. Consequently, screen savers can degrade network performance. FORE recommends setting the screen saver to "none" or "blank" on server machines.

CHAPTER 6

Windows 95 Installation

This chapter describes how to install the FORE ATM drivers on a Windows 95 operating system and gives requirements for the FORE drivers.

6.1 Procedures for all FORE PC Adapters

These procedures can be used to install the Windows 95 drivers for any of the FORE PC adapters:

- ForeRunnerLE, also referred to as the LE adapter
- PCA-200EPC, also referred to as the PCA adapter

In the examples throughout the chapter, the examples show the installation of the driver for an *LE* adapter. During the installation, the model name for your adapter will appear in the dialog boxes relating to the ATM adapter driver.

6.2 The FORE ATM and LANE Drivers

As shown in Figure 6.1, you must install both a FORE ATM driver and one or more of the following FORE drivers:

- Emulated LAN (ELAN) driver to connect to an Emulated LAN.
- IP over ATM (RFC 1577) (referred to as Classical IP or CLIP) driver to connect to a CLIP Logical IP Subnet (LIS).

Contact your system administrator for information about which drivers you must install.

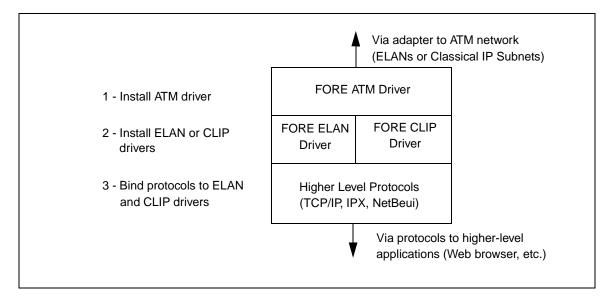


Figure 6.1 - FORE Driver Configuration

6.3 Installation Requirements

Requirements to ensure proper installation of the FORE drivers are:

- Approximately 1 MB of free disk space in the installation directory file system
- 16 MB of RAM minimum
- Microsoft Windows 95
- A PCI 2.0/2.1 specification compliant PC that appears on the Microsoft, Inc., Hardware Compatibility List
- Successful installation of the FORE adapter card (see Chapter 2)
- ForeThought 4.1 software CD



If you must install the files from a diskette, refer to the README.TXT file on the CD for information about creating a Windows NT installation diskette.

The relevant files on the *ForeRunner* software CD are listed in Table 6.1.

Table 6.1 - Relevant Files on the *ForeThought* CD

Driver Files for Windows 95	
/LE	FOREINFO.HLP
/PCA	FORELAN.HLP
!FSI2001.CFG	FORELAN.VXD
!FSI2002.CFG	FORENDI.DLL
!FSI2003.CFG	FORESTAT.CPL
CRDISK.BAT	FORESTAT.EXE
FOREADP.HLP	FOREUNI.HLP
FORECLIP.VXD	FOREVIR.HLP
FORECLP1.HLP	NETFORE.INF
FORECLP2.HLP	NETFORE.INF.LE
FORECLP3.HLP	NETFORE.INF.PCA
FOREHLPR.EXE	REGUTIL.EXE
FOREINFO.EXE	UPGRADE.EXE

6.4 Installing the FORE Adapter Software

Installation of the FORE ATM adapter software on Windows 95 consists of the following steps:

1. Install the FORE ATM Adapter driver when the adapter is automatically discovered by Windows 95 via plug-and-play.



This chapter also describes how to use the System control panel to install the ATM Adapter driver in circumstances when Windows 95 does not auto-discover the adapter and prompt for installation of the driver. See "Installing the ATM Driver Manually" on page 6-29.

- 2. Reboot the system.
- 3. Configure the FORE ATM Adapter driver for each adapter card that has been installed on your PC. This is required *only* if one of the following is true:
 - You are not using ILMI and must manually enter the ATM address of the host.
 - You want to change the default transmit or receive buffer and queue sizes.
- 4. Install and configure one or more of the following:
 - a. A ForeRunner ELAN Adapter driver for each ELAN to which you want to connect.
 - b. A *ForeRunner* IP over ATM (RFC 1577) Adapter driver for each Classical IP LIS to which you want to connect.

You can install up to four copies of each driver, as long as you remain within Windows 95 networking limitations.

Reboot the system.

Windows 95 offers a variety of methods for installing and upgrading your networking software. This chapter describes how to use the Network control panel to install and configure your FORE drivers.

6.4.1 Installing the FORE ATM Adapter Driver

After installing the FORE ATM adapter hardware, when you start up your PC, Windows 95 automatically discovers the new hardware and displays the New Hardware Found dialog box, shown in Figure 6.2.



Figure 6.2 - New Hardware Found Dialog Box

This dialog box displays the type of the adapter and gives options for installing the driver. Use the following procedure to install the ATM driver at this point:

- 1. Accept the default option, Driver from disk provided by hardware manufacturer and click OK. The Install from Disk dialog box appears, specifying the A: drive.
- 2. Insert the *ForeThought* software CD in the CD-ROM drive and change the path to indicate <code>D:\WIN95</code>, where D: indicates your CD-ROM drive. If your CD-ROM drive is assigned a different letter, use the appropriate drive letter.

- Click <OK>. A progress bar appears, showing the files being copied to your hard drive.
- A warning appears, reminding you that you must install an ELAN or CLIP driver. Click Oκ to proceed. Additional files are copied. You can then eject the software CD.
- 5. A prompt appears, asking you to load the Windows 95 CD-ROM. If you have installed Windows 95 already, you can specify the directory containing the required files.
- 6. If you have installed additional adapters, you are prompted to install additional adapters. Otherwise, a prompt appears, asking you to re-boot the system. Reboot the system as prompted.
- 7. After the system reboots, proceed to install the *ForeRunner* ELAN or CLIP adapter, as described in the following sections:
 - "Installing the Emulated LAN Adapter Driver" on page 6-12
 - "Installing the IP Over ATM (RFC 1577) Driver" on page 6-20.

6.4.1.1 Manually Installing the Driver

You may have to install the FORE ATM driver manually in the following situations:

- At some previous time, when the adapter card was discovered by Windows 95 at boot-up and the New Hardware Found dialog box appeared, the Do not install a driver (Windows will not prompt you again) option was chosen.
- Another adapter had been previously installed in the machine.

In these cases you must use the procedure in "Installing the ATM Driver Manually" on page 6-29.

6.4.2 Configuring the FORE ATM Adapter Driver (If Necessary)

Windows 95 installs the FORE ATM driver using the default values. If these default values are not acceptable for your site, you must configure the driver using the following procedure. You must configure the driver if one of the following is true:

- You are not using ILMI.
- You want to change the default transmit or receive buffer and queue sizes (the default values, which are acceptable for most sites, are listed on page 6-10).

Contact your system administrator to determine if any of these conditions apply to you. Use the following procedure if you must configure the FORE ATM Adapter driver:

- 1. Display the Network control panel (shown in Figure 6.3) by using the following procedure:
 - a. Choose the Start button on the Taskbar.
 - Choose Settings.
 - b. Choose Control Panel. The Control Panel appears.
 - c. Double-click on the Network icon.

The Network control panel appears, as shown in Figure 6.3.

2. Select the ForeRunner (xxx) ATM Adapter in the list of installed network components and choose the **Properties** button.

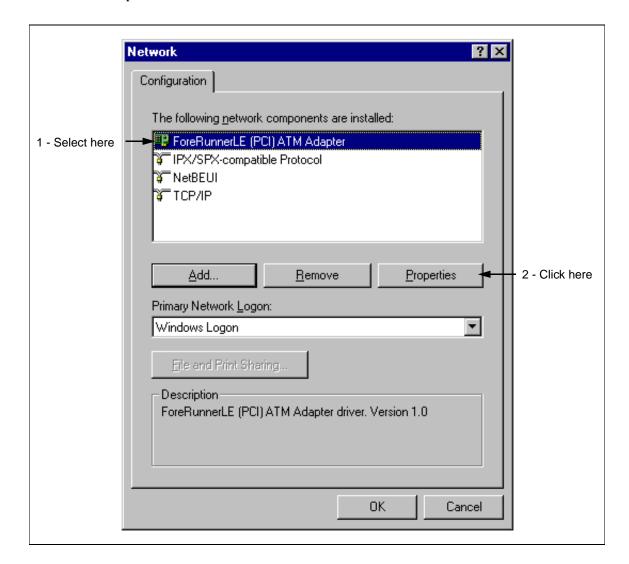


Figure 6.3 - Network Control Panel

3. The ForeRunner (xxx) ATM Adapter Properties dialog box appears, as shown in Figure 6.4. This dialog box contains six tabs. The only tabs you may have to edit are Adapter Configuration and UNI Configuration. You can ignore the Driver Type, Bindings, and Advanced tabs.

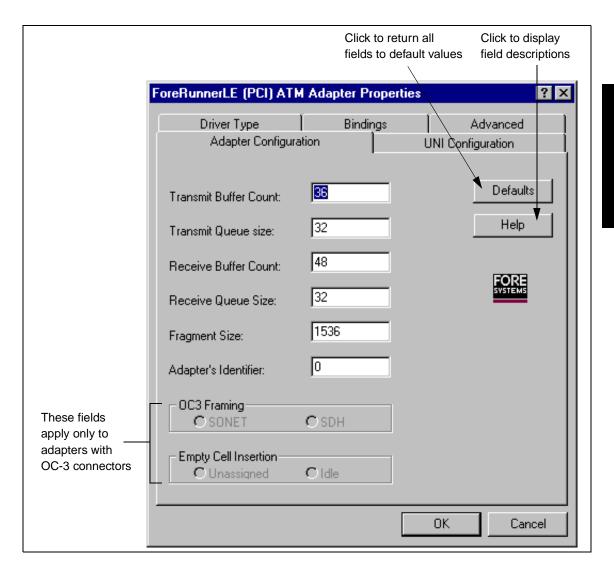


Figure 6.4 - ForeRunner FORE ATM Adapter Configuration Tab



Any changes to values appearing in this dialog box take effect only when the system is rebooted.

4. Click on the Adapter Configuration tab. The adapter configuration information appears, as shown in Figure 6.4.

If you have installed multiple adapters - Note the number in the Adapter's Identifier field. You need this information when configuring the ForeRunner ELAN or IP over ATM driver or drivers associated with this physical adapter. (Zero indicates the first adapter.)

- 5. Modify the fields of the Adapter Configuration tab to conform to your system requirements (the default values are adequate for most installations).
- 6. Click on the UNI Configuration tab to display the UNI parameters for the adapter, as shown in Figure 6.5. By default, ILMI Enabled is selected and you cannot modify the local ATM address of the adapter. Select the Disabled radio button if you want to enter the local ATM address and UNI version of the adapter manually.



If you disable ILMI and the UNI Version parameter was set to Auto UNI, the UNI Version reverts to UNI 3.0 (because the driver can no longer use ILMI to determine the UNI version). You *must* use the same version of UNI as that used by the ATM switch to which the adapter is connected. Get the correct values from your system administrator.

If you don't know the MAC address - If you aren't using ILMI and don't know the MAC address, you can specify mm for each two-byte portion of the MAC/ESI address. The adapter then automatically provides the address when it starts up.

Refer to "How to Specify an ATM Address" on page 3-4 for information about the format of an ATM address.

7. Choose the **OK** button to save the changes you have made.

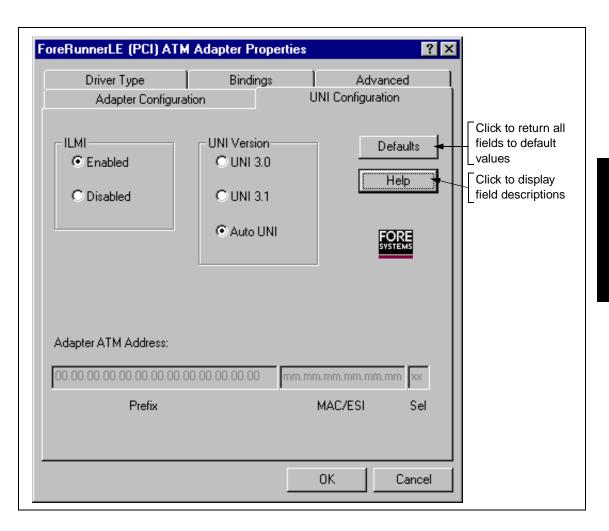


Figure 6.5 - UNI Configuration Tab

- 8. The Network control panel appears with the ForeRunner ATM Adapter driver in the list of installed network components.
- 9. Proceed to do either or both of the following:
 - a. Install one or more *ForeRunner* Emulated LAN Adapter drivers using the procedure in "Installing the Emulated LAN Adapter Driver" on page 6-12.
 - b. Install one or more *ForeRunner* IP Over ATM Adapter drivers using the procedure in "Installing the IP Over ATM (RFC 1577) Driver" on page 6-20

6.4.3 Installing the Emulated LAN Adapter Driver



You must repeat this procedure for each ELAN that you want to join. You can install a maximum of four ELAN adapter drivers.

Use the following procedure to install one or more *ForeRunner* Emulated LAN Adapter drivers on a Windows 95 system:

1. In the Network control panel, choose the Add... button. The Select Network Component Type dialog box appears, as shown in Figure 6.6.

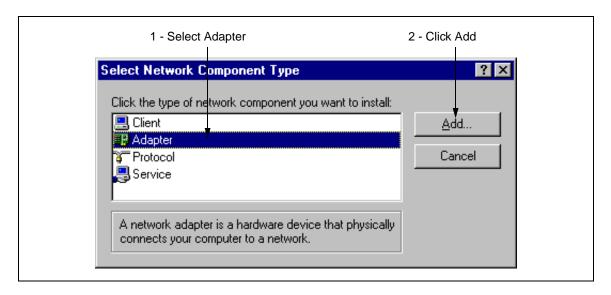


Figure 6.6 - Select Network Component Type Dialog Box

2. Select Adapter. Then, click the Add button. A progress bar is displayed as Windows 95 builds an adapter database. The Select Network adapters dialog box appears, as shown in Figure 6.7.

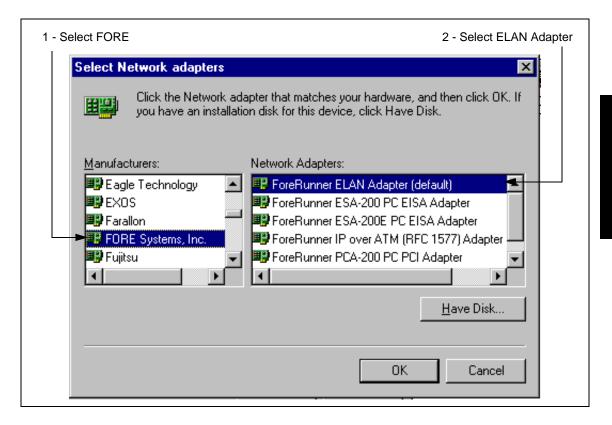


Figure 6.7 - Select Network Adapters Dialog Box

- 3. Select Fore Systems, Inc. and ForeRunner ELAN Adapter. The Network control panel appears with the ELAN driver in the list of installed network components, as shown in Figure 6.8.
- 4. If you are using all of the default values for the driver:
 - Using the LANE services (the LES and LECS)
 - Using the automatic ELAN name (in which the driver finds out which ELAN to join from the LECS)
 - Using other default values (such as using Ethernet rather than Token Ring) You don't have to configure the ELAN driver. Skip ahead to step 8.

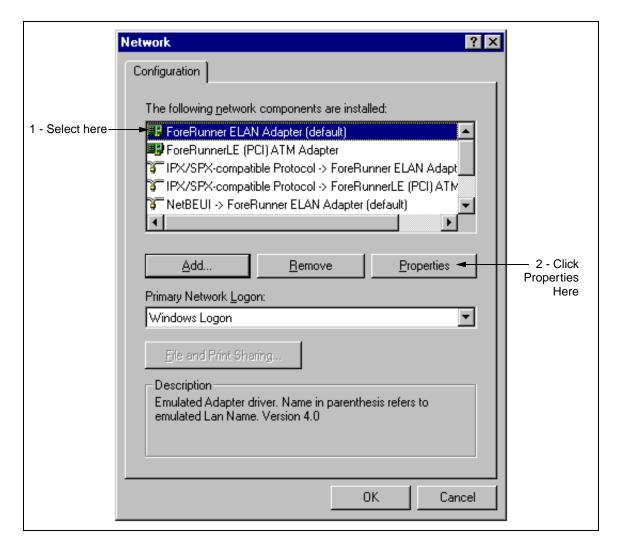


Figure 6.8 - Network Control Panel with ELAN Driver

- 5. Select ForeRunner ELAN Adapter and choose Properties, as shown in Figure 6.8. The ForeRunner ELAN Adapter Properties dialog box appears, as shown in Figure 6.9. The only tabs you may have to edit are the Basic ELAN Conf and ELAN LECS/LES Conf tabs. You can ignore the Driver Type, Bindings, and Advanced tabs.
- 6. Edit the fields on the Basic ELAN Conf tab as required.

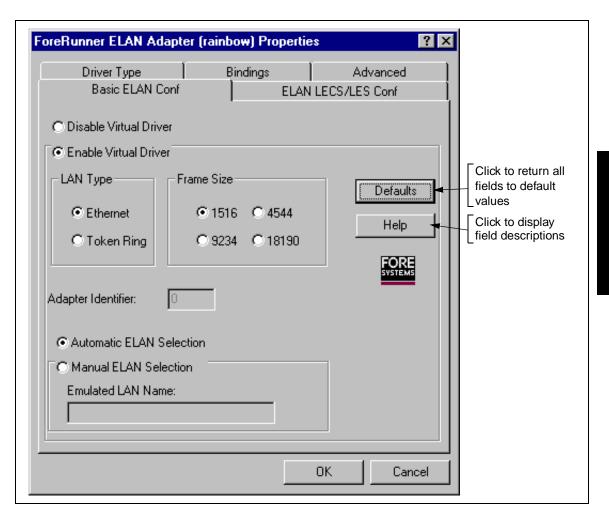


Figure 6.9 - Basic ELAN Conf Tab

- a. If you want to disable this driver, so it does not start when the system is rebooted, select Disable Virtual Driver. When this option is selected, all parameters for the driver are grayed out and cannot be edited.
- b. Select the type of ELAN to which this driver connects, Ethernet or Token Ring.
- c. Select the appropriate Frame Size. This value must match the frame size of other hosts on the ELAN.

- d. If you have more than one FORE adapter in this machine, you must specify the adapter you want to use in the Adapter Identifier box. This field is read-only if only one FORE ATM adapter is installed.
 - The adapter identifier for each adapter was assigned in step 8 of the previous procedure, "Installing the FORE ATM Adapter Driver" on page 6-5.
- e. If you are using an LECS, you can choose Automatic ELAN Selection in order to use the default ELAN specified by the LECS. In this case you don't need to enter a value in the Emulated LAN Name field, and can proceed to step 7.



If you use Automatic ELAN Selection, you must still specify the ELAN type and MTU size (or accept the default). If no ELAN has been specified on the LECS that matches these parameters, the Automatic ELAN Name feature will not work. Use the InFOREmation Center utility, described in Chapter 7, to determine the name of the ELAN that the driver has joined.

This feature can only be used on one ELAN driver. For all other ELAN drivers, you must specify the ELAN name.

- f. Enter the Emulated LAN Name that you want to join. Any valid alphanumeric name up to 32 characters long may be specified.
 - Specifying a LES failover sequence If the LECS has been configured to support failovers in the event of the failure of a LES, you can specify a failover sequence when you specify the ELAN name. To do this, specify the ELAN name, a vertical bar, and a range corresponding to the backup ELANs you want this LEC to contact if one or more LES's fail. For example, if the ELAN name is prod, and a total of five ELANs for prod have been configured, and you want to attempt each of the five in the event of multiple LES failures, specify the following in the Emulated LAN Name field:

prod | 1-5

7. Click on the ELAN LECS/LES Conf tab to display the LECS and LES parameters for the adapter, as shown in Figure 6.10. By default, the Yes radio button in the Use LECS box and the Enabled radio button in the Discover LECS box are selected.

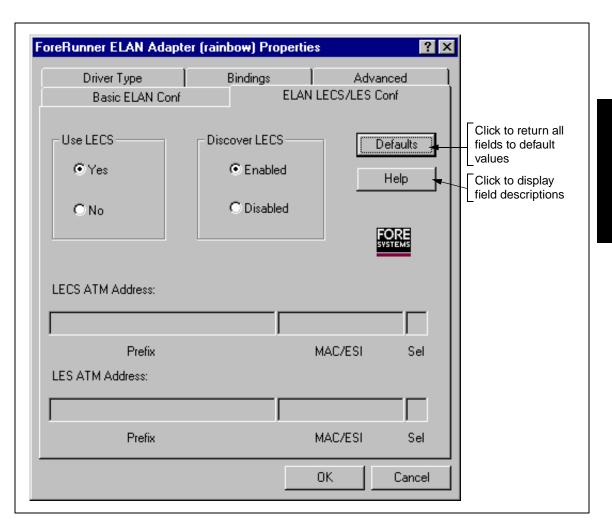


Figure 6.10 - ELAN LECS/LES Configuration Tab

a. Indicate whether or not you are using an LECS. If you are using the LECS, you don't have to specify the LES address or an ELAN name (if the Automatic ELAN Name has been configured in the LECS).

- b. Indicate whether or not the driver should attempt to contact the LECS automatically. If you enable discovery of the LECS, you don't have to specify the LECS address.
- c. The LECS ATM Address field contains the address for the LAN Emulation Configuration Server (LECS).
 - If you are using an LECS but Discover LECS is disabled, you must specify the LECS address in this field.
- d. The LES ATM Address field contains the address for the LAN Emulation Server (LES) associated with this ELAN.
 - If the LECS is not configured LECS Use is Disabled is displayed above the address field. You must specify the LES ATM address. Refer to "How to Specify an ATM Address" on page 3-4 for information about the format of an ATM address.
- 8. Choose the OK button when you are finished configuring the *ForeRunner* ELAN adapter driver. The Network control panel appears, with the ForeRunner ELAN Adapter driver in the list of installed network components. A description of the adapter appears in the Description field when the ELAN adapter is selected.

Figure 6.11 shows an example of the Network control panel with the driver and an ELAN driver installed.



If you change the name of the ELAN, the old name will still appear in the installed network components list until you exit the Network control panel and re-enter it.

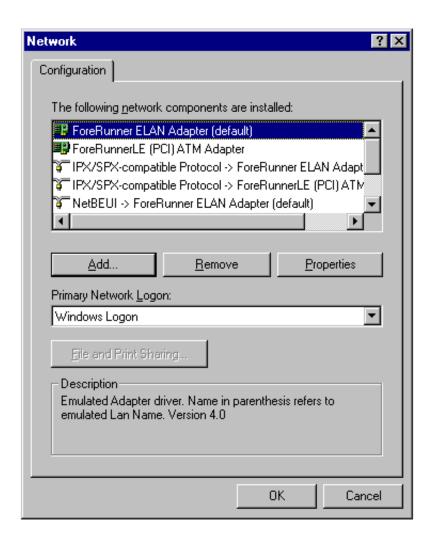


Figure 6.11 - Network Control Panel with an ELAN Driver Installed

9. Do one of the following:

- Return to the beginning of this procedure to install additional ELAN drivers.
- a. Proceed to "Installing the IP Over ATM (RFC 1577) Driver" on page 6-20 to install one or more Classical IP drivers.
- b. Proceed to "Binding Protocols to the ELAN and IP Over ATM Drivers" on page 6-27 if you have installed all ELAN and IP over ATM drivers.

6.4.4 Installing the IP Over ATM (RFC 1577) Driver

Use the following procedure to install one or more IP Over ATM (RFC 1577) drivers on a Windows 95 system. This driver can be used to connect to a Classical IP LIS.



You must repeat this procedure for each LIS that you want to join. You can install a maximum of four IP Over ATM (RFC 1577) adapter drivers.

1. In the Network control panel, choose the Add button. The Select Network Component Type dialog box appears, as shown in Figure 6.12.

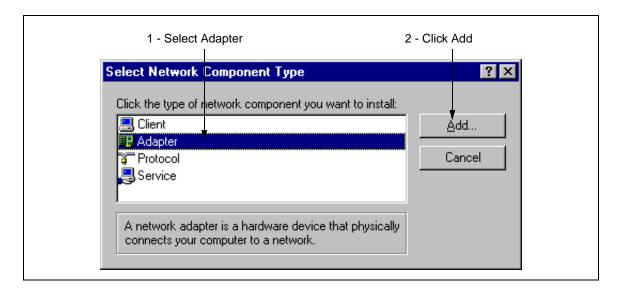


Figure 6.12 - Select Network Component Dialog Box

2. Select Adapter. Then, choose the Add button. If this is the first IP Over ATM or ELAN driver you've installed, a progress bar is displayed as Windows 95 builds an adapter database. The Select Network adapters dialog box appears, as shown in Figure 6.13.

3. Select Fore Systems, Inc. and ForeRunner IP over ATM (RFC 1577) Adapter, as shown in Figure 6.13. Depending on what FORE drivers you have installed previously, you may be prompted for FORE driver files. Insert the ForeThought software CD, indicate the path (D:\WIN95, assuming D: is your CD-ROM drive), and proceed.

The Network control panel appears with the IP Over ATM driver in the list of installed network components, as shown in Figure 6.14.

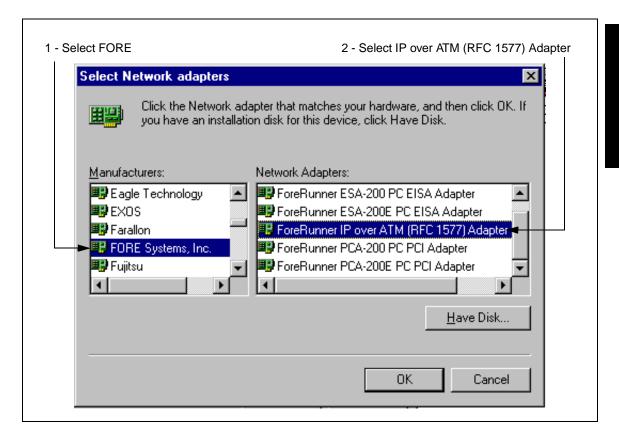


Figure 6.13 - Select Network Adapters Dialog Box

4. Select ForeRunner IP over ATM (RFC 1577) Adapter and choose Properties, as shown in Figure 6.14. The ForeRunner IP over ATM (RFC 1577) Adapter Properties dialog box appears, as shown in Figure 6.15.

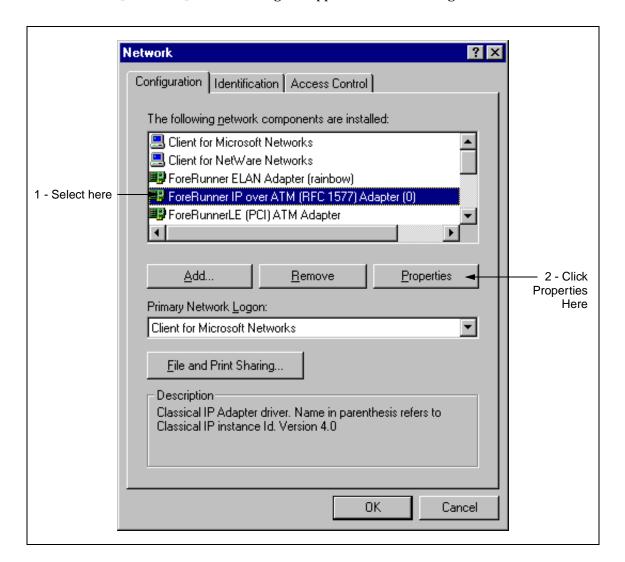


Figure 6.14 - Network Control Panel with IP Over ATM Driver

5. Edit the Adapter Configuration parameters as necessary for your site. The only tabs you may have to edit are the Adapter Configuration, Configuration Params, and PVC Connections tabs. You can ignore the Driver Type, Bindings, and Advanced tabs.

You must specify the ATM address of the ARP Server that this driver uses to resolve addresses of other hosts. Get this address from your system administrator. You must also specify an identifier for this CLIP driver. For other parameters you can use the defaults unless directed otherwise by your system administrator.

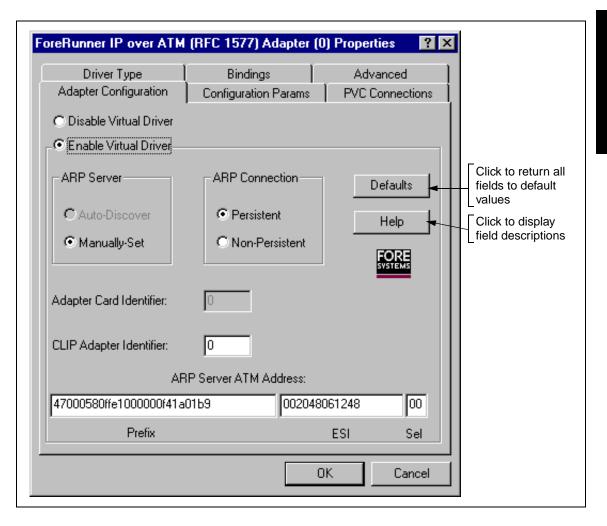


Figure 6.15 - Adapter Configuration Tab

- 6. Choose the Configuration Params tab, shown in Figure 6.16.
- 7. Edit the configuration parameters as necessary for your site.

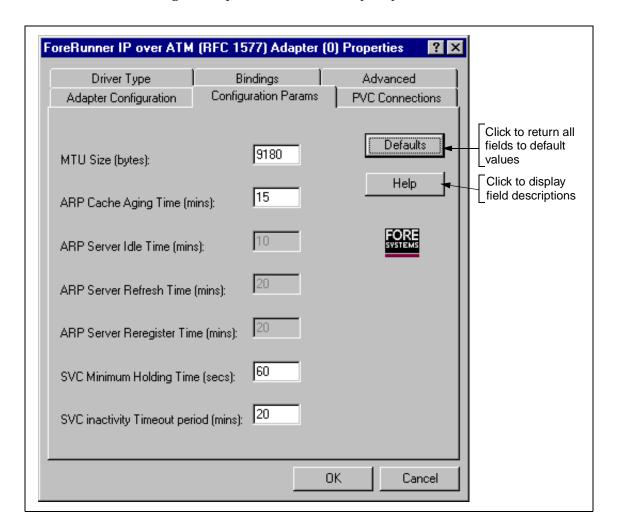


Figure 6.16 - Configuration Params Tab

8. If you must manually enter PVC connections for the driver, choose the PVC Connections tab, shown in Figure 6.17. Contact your system administrator for any PVCs you may have to add.

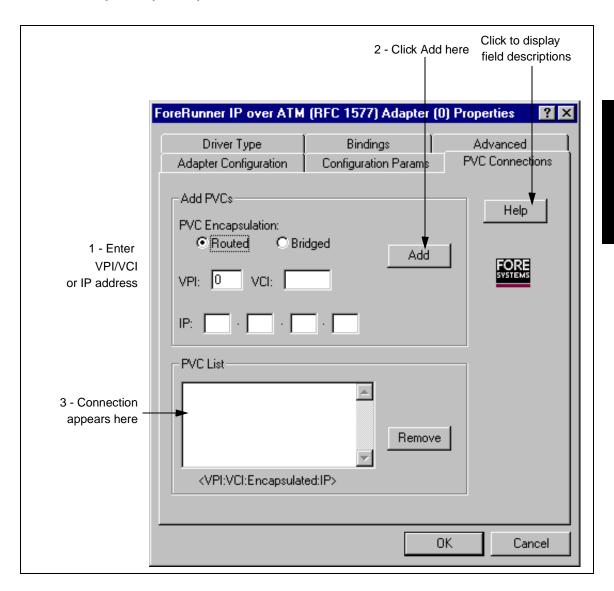


Figure 6.17 - PVC Connections Tab

- a. Enter the VCI for the PVC connection (the VPI is always zero) or check the Use IP Address option and specify the IP address of the destination host. Only VPI 0 is supported. Also, please note that VCI's 0 through 31 are reserved by the ATM Forum, and that the FORE drivers support a limit of 1024 VCI's.
- b. You can accept the default encapsulation (Routed). Bridged encapsulation is not available in this release.
- c. Choose the Add button. The connection appears in the PVC List.

Repeat these steps for additional PVC connections.

Removing Connections from the List - To remove a connection from the list, highlight the connection by clicking on it in the list and choose the **Remove** button.

- 9. Do one of the following:
 - Return to the beginning of this procedure to install additional IP Over ATM drivers.
 - b. Proceed to "Binding Protocols to the ELAN and IP Over ATM Drivers" on page 6-27 if you have installed all ELAN and IP over ATM drivers.

6.4.5 Binding Protocols to the ELAN and IP Over ATM Drivers

6.4.5.1 Binding Limitations in Windows 95

Windows 95 allows up to eight bindings per network protocol (IPX, NetBEUI, or TCP/IP). There is also a NetBios restriction of a combined total of eight protocol bindings using NetBEUI and TCP/IP. If you have a total of more than eight protocol bindings using NetBEUI and TCP/IP, your system may hang at boot-up. For example, if you have bound five drivers to TCP/IP, you can only perform three bindings to NetBEUI, because the total number of TCP/IP and NetBEUI bindings cannot exceed eight.

6.4.5.2 Binding the Protocols

Use the following procedure to complete the installation:

1. Bind any network protocols to the ELAN or IP Over ATM driver or drivers, as required by your site, and within Windows 95 networking limitations.

To configure the bindings, select the binding in the list of installed network components in the Network control panel and click the Properties button. If you select the TCP/IP binding, the TCP/IP Properties dialog box is displayed, as shown in Figure 6.18.

Contact your system administrator for any addresses (such as TCP/IP) you may need. If your site is using the Dynamic Host Configuration Protocol (DHCP), you do not need to specify a TCP/IP address.

For specific instructions about Windows 95 network configuration, please consult your system administrator and the appropriate Windows 95 documentation.



The IP Over ATM driver only binds to TCP/IP. The ELAN driver can bind to TCP/IP, NetBeui, or IPX/SPX.



You must bind network protocols to each ELAN or IP Over ATM driver you have installed separately, and assign each ELAN a distinct address.



If you are using automatic ELAN selection and TCP/IP, you must still get the appropriate TCP/IP address for your host on that ELAN.

Choose the OK button. You are prompted to reboot the system. Choose the Restart Now button. The ForeRunner adapter driver installation is now complete. When the PC reboots, the FORE ATM, ELAN and IP over ATM drivers are loaded.

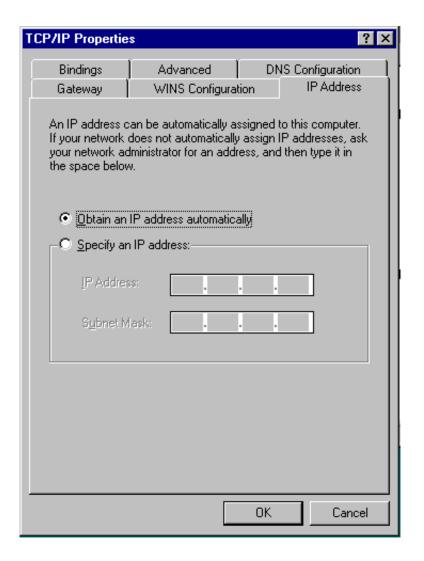


Figure 6.18 - TCP/IP Properties Dialog Box

6.4.6 Installing the ATM Driver Manually

You must install the ATM driver manually (as opposed to installing it when Windows 95 discovers the adapter when booting up) if you choose "Do not install driver at this time" when Windows 95 discovered the LE or PCA adapter when booting up.

Also, if you removed the LE or PCA ATM drivers and later want to re-install or upgrade them, or other ATM adapter drivers have been installed, occasionally Windows 95 may not recognize that the drivers had been removed and will automatically re-install the old drivers.

Use the following procedure to install the ATM driver manually:

- Display the System Properties control panel by using the following procedure:
 - a. Choose the Start button on the Taskbar.
 - a. Choose Settings.
 - b. Choose Control Panel. The Control Panel appears.
 - c. Double-click on the System icon.

The System Properties control panel appears.

2. Choose the Device Manager tab.

The Device Manager information appears, as shown in Figure 6.19. A question mark appears next to the PCI card.

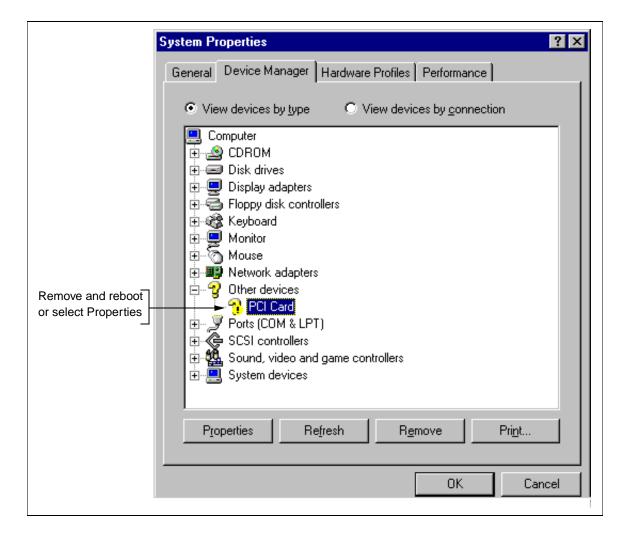


Figure 6.19 - Device Manager Tab

- 3. At this point, you have two options:
 - a. You can remove the unknown card from the list by highlighting it and choosing the Remove button. You can then reboot the machine. Windows 95 will discover the adapter and you can proceed to install the driver as described in "Installing the FORE ATM Adapter Driver" on page 6-5.
 - b. You can continue with the manual installation by proceeding to step 4 of this procedure.

- 4. Select the PCI card and choose the Properties button.

 The PCI Card Properties dialog box appears.
- 5. Select the Driver tab. The Driver information appears, as shown in Figure 6.20.

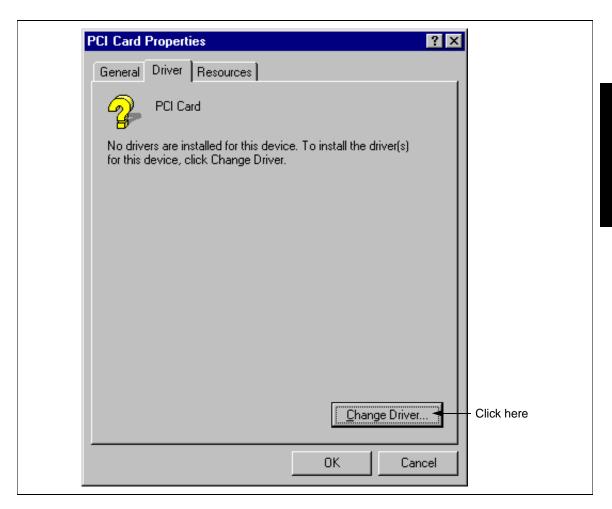


Figure 6.20 - PCI Card Driver Tab

6. Choose the Change Driver... button, as shown in Figure 6.20. The Select Hardware Type dialog box appears, as shown in Figure 6.21.

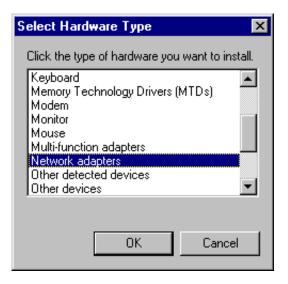


Figure 6.21 - Select Hardware Type Dialog Box

- 7. Choose Network Adapters and choose the OK button. The Select Device dialog box appears.
- 8. Choose the Have Disk... button. The Install from Disk dialog box appears.
- 9. Insert the *ForeThought* software CD in the CD-ROM drive and change the path to indicate **D:\WIN95**, where D: indicates your CD-ROM drive.
- 10. Press <ENTER>. The Select Device dialog box reappears, listing the driver for your adapter.
- 11. Choose the OK button to install the driver. The driver now appears in the Device Manager tab of the System Properties dialog box. A prompt appears, asking if you want to restart the PC now to incorporate the changes.
- 12. Choose the Restart Now button. The *ForeRunner* ATM adapter driver installation is now complete. You must proceed to install the ELAN driver, as described in "Installing the Emulated LAN Adapter Driver" on page 6-12.

6.5 Upgrading the FORE Adapter Software

CAUTION



When upgrading the FORE drivers on Windows 95, always use the UPGRADE utility provided by FORE, as described in this procedure. Attempting to upgrade the drivers by deleting old drivers manually may lead to problems with your Windows 95 system.

Use the following procedure to upgrade previously installed *ForeThought* ATM software on your Windows 95 workstation:

- 1. Insert the *ForeThought* software CD in the CD-ROM drive.
- Display the Run dialog box by choosing the Start button and then choosing Run....
- 3. Specify D:\WIN95\UPGRADE.EXE in the Open: field, where D: indicates your CD-ROM drive, as shown in Figure 6.22.

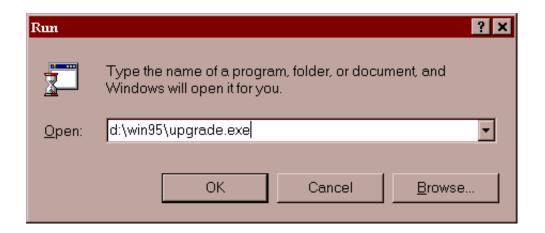


Figure 6.22 - Running the UPGRADE.EXE File

4. Choose the OK button. The ForeThought Upgrade dialog box appears, as shown in Figure 6.23.

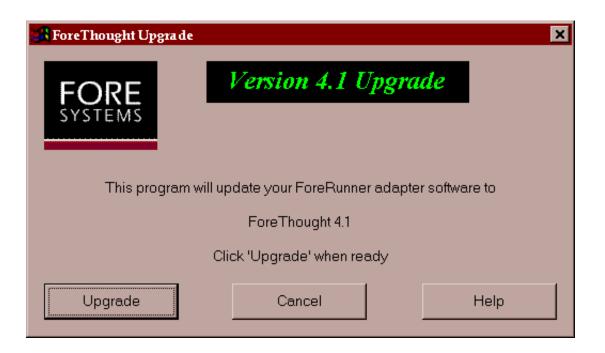


Figure 6.23 - ForeThought 4.1 Upgrade Dialog Box

5. Choose the **Upgrade** button.

A progress bar appears, showing the files being upgraded from the media.

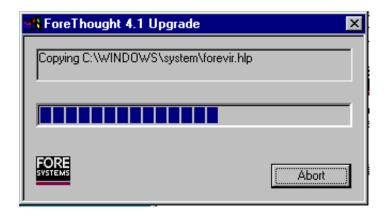


Figure 6.24 - ForeThought 4.1 Upgrade Progress Dialog Box

6. After the files are copied from the CD, a prompt appears, asking if you want to restart the computer in order to implement the new files. Choose Yes.



Figure 6.25 - Restart Prompt

After the computer restarts, the upgrade process is complete.

Windows 95 Installation



Viewing ATM Statistics in Windows NT and Windows 95

The InFOREmation Center application provides performance monitoring and debugging tools that allow you to view and log a number of ATM parameters and statistics. With the InFOREmation Center application, you can display the following information:

- Information about each LAN Emulation ELAN and Classical IP LIS to which the currently installed drivers are connected
- The list of current connections established by the currently installed drivers
- Information about each FORE adapter currently installed in your machine
- AAL traffic and transmission error statistics

7.1 Starting the InFOREmation Center

To start the Statistics application, double-click on the FORE Systems icon in the Windows control panel, as shown in Figure 7.1.

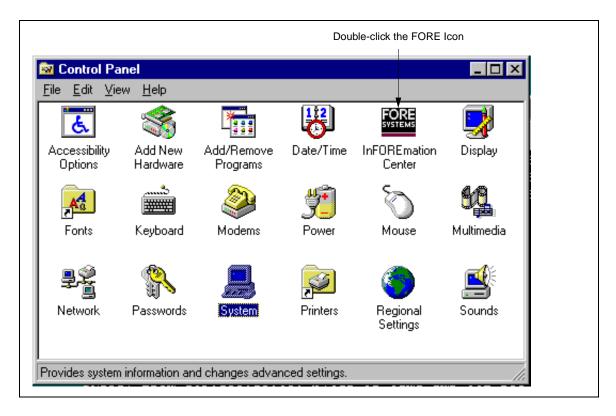


Figure 7.1 - Starting the InFOREmation Center

7.2 Menus in the InFOREmation Center

The menus presented by the InFOREmation Center are:

File Allows you to Exit the InFOREmation Center.

Options Allows you to refresh the VLAN or Adapter

information, to set the automatic refresh interval,

and to return all statistic counters to zero.

Window Allows you to toggle between the VLAN

Information and Adapter Information

windows.

Help Allows you to display on-line help for the

InFOREmation Center.

7.3 Using the VLAN Information Window

Figure 7.2 shows the VLAN Information window. It provides a wide range of information about current ATM connections through installed Classical IP and Emulated LAN drivers.

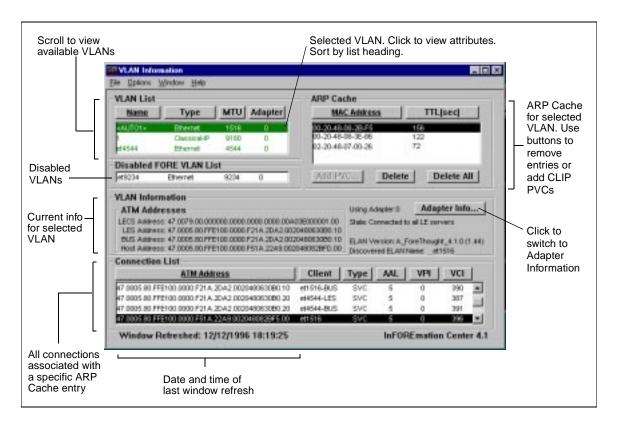


Figure 7.2 - The VLAN Information Window

From the VLAN Information window, you can:

- View the list of ELANs and Classical IP LISs to which this host is connected.
- View information about the VLAN, including related ATM addresses and status.
- View Connections and ARP Cache entries for a VLAN by selecting it in the VLAN List.

Refer to Table 7.1 for references to information on the VLAN Information Window.

Table 7.1 - Viewing the Adapter Information Window

For a description of	Refer to
The VLAN List	"The FORE VLAN List" on page 7-6
The ARP Cache	"ARP Cache Table" on page 7-7
The VLAN Information	"VLAN Information Table" on page 7-10
The Connection List	"Connection List Table" on page 7-9

7.3.1 Sorting the Lists

All lists in the VLAN Information window are sortable by the list heading. For example, clicking on Name will re-sort the entries by name, Type sorts by type, etc.

7.3.2 The FORE VLAN List

This list displays information about the ELANs or CLIP LISs to which the host is connected.

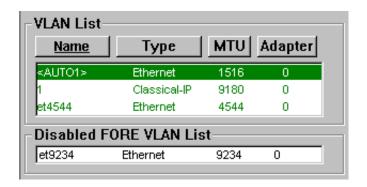


Figure 7.3 - VLAN List Portion of VLAN Information Window

Name	Name assigned to the selected ELAN. If the name is provided by the LECS, <auton> appears in the list. The Discovered ELAN Name field gives the actual name of the ELAN.</auton>
Туре	Type of VLAN, either a Classical IP LIS or an Ethernet or Token Ring ELAN.
MTU	Maximum Transmission Unit in bytes. This is the largest packet data unit size that is transmittable over the VLAN.

Unit number of the FORE adapter over which this

Selecting an ELAN's line entry in the VLAN List displays all information pertaining to it across all windows in the VLAN Information screen.

connection is running.

7.3.2.1 Disabled FORE VLAN List

Adapter

This list displays the installed VLAN drivers that have been disabled. The drivers are disabled by selecting the Disable Virtual Driver field when configuring the ELAN or IP Over ATM driver via the Network control panel.

This list appears only if one or more VLAN drivers on the host have been disabled.

7.3.2.2 VLAN Status Colors

The VLANs are color-coded to correspond with their individual connectivity state:

Green Indicates full connectivity. For ELAN connections, the host is connected to the LES and BUS. For

Classical IP connections, the host is connected to the

ARP server.

Yellow Indicates partial connectivity. For ELAN connections,

the host has the LES address but is not connected. For Classical IP connections, the host has the ARP

server address but is not connected.

Red Indicates no connectivity.

7.3.3 ARP Cache Table

This table displays the ARP Cache for the VLAN selected in the VLAN list. For ELAN connections, this table lists MAC Addresses for other LECs on the selected ELAN. For Classical IP connections, this table lists IP addresses for other hosts in the LIS.

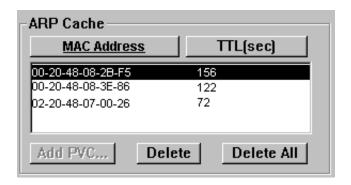


Figure 7.4 - ARP Cache Portion of VLAN Information Window

MAC/IP Address The MAC or IP address of other hosts on the specified VLAN.

"TTL (sec)

"Time to Live" or the amount of time, in seconds, allotted for a connection. If no data traffic moves across the cache entry in the allotted time, the cache entry is automatically removed from the ARP Cache.

If you select an entry in the ARP Cache table, the corresponding entry is highlighted in the Connection List (see "Connection List Table" on page 7-9.)



Because Token Ring and Ethernet LANs transmit MAC addresses in opposite bit order, Token Ring and Ethernet MAC addresses are shown in opposite bit order.

7.3.3.1 Add PVC... Button

This button displays the Add PVC dialog box, allowing you to add a PVC connection manually to a host in a Classical IP LIS.

7.3.3.2 Delete and Delete All Button

The Delete button deletes a highlighted entry from the ARP Cache, and is active only after an ARP Cache entry has been highlighted. The Delete All button deletes all entries from the ARP cache.

7.3.4 Connection List Table

This table displays the ATM addresses of all connections currently maintained by this host.

Connection List————————————————————————————————————						
ATM Address	Client	Туре	AAL	VPI	VCI	
47.0005.80.FFE100.0000.F21A.2DA2.0020480630B0.10	et1516-BUS	SVC	5	0	390	
47.0005.80.FFE100.0000.F21A.2DA2.0020480630B0.20	et4544-LES	SVC	5	0	387	
47.0005.80.FFE100.0000.F21A.2DA2.0020480630B0.20	et4544-BUS	SVC	5	0	391	
47.0005.80.FFE100.0000.F51A.22A9.002048082BF5.00	et1516	SVC	5	0	396	
·						

Figure 7.5 - Connection List Portion of VLAN Information Window

ATM Address	Displays the ATM Address of the connection		
Client	Displays the ELAN on which the connection resides. Also indicates if the connection is to one of the LANE Services (LECS, LES, or BUS), or to the ARP Server.		
	If the client name is too long to fit in the display field, the name is truncated, as indicated with an asterisk (*). For example, the client name et1516production-BUS would appear as et1516product*-BUS.		
Туре	Indicates connection types. SVC for switched virtual circuit, for example.		
AAL	Indicates the ATM Adaptation Layer type. This field always displays 5.		
VPI	Indicates the Virtual Path Identifier.		
VCI	Indicates the Virtual Channel Identifier.		

Selecting an entry in the ARP Cache table highlights a corresponding connection entry in the Connection List. The Connection List automatically scrolls to the relevant entry if it is not within view.

7.3.5 VLAN Information Table

This table displays general information about the selected VLAN. The information displayed varies depending on whether the VLAN is a LAN Emulation ELAN or a Classical IP LIS.

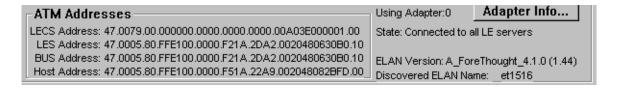


Figure 7.6 - VLAN Information Portion of VLAN Information Window

7.3.5.1 If the Connection is an ELAN

The ATM Addresses table provides the ATM addresses of the ELAN's LANE service components as well as the host itself.

LECS Address	Displays the address of the LAN Emulation Configuration Server. If a LECS is not being used, this field is not displayed.	
LES Address	Displays the address of the LAN Emulation Server.	
BUS Address	Displays the address of the Broadcast and Unknown Server.	
Host Address	Displays the address of the LAN Emulation Client (i.e., this machine.)	

7.3.5.2 If the Connection is a Classical IP LIS

The ATM Addresses table lists the address of the ARP server associated with the LIS and the ATM address of the host.

7.3.5.3 Using Adapter Field

This field indicates which adapter is used by the selected VLAN, if multiple adapters are installed.

7.3.5.4 State Field

If the driver has successfully connected to the ELAN, the Connected to all LE servers message is displayed. Otherwise, an error message appears in this field. Refer to Appendix D on page D-1 for detailed explanations of the nature of each problem and possible solutions.

7.3.5.5 ELAN/CLIP Version Field

This field indicates the driver version number and build number. For the current release, the version is to 4.1.0.

7.3.5.6 Failover Index Field (ELAN Only)

This field indicates which failover ELAN the host is using, and also indicates the range of failover ELANs. (Refer to "Failover ELANs" on page 1-5 for information on failover ELANs.) The index range is 1 to 9. An example entry in this field might read:

```
Failover Index: 3 (in range 1-9)
```

This indicates that the host is using the third ELAN in a range of nine. If the host is not connected to an ELAN in the failover range, it is designated as unassigned:

```
Failover Index: Unassigned (in range 1-9)
```

If the selected ELAN is not a failover ELAN, this field is not displayed.

7.3.5.7 Discovered ELAN Name Field (ELAN Only)

This field indicates the name of the ELAN to which the host is actually connected, if the ELAN name was supplied by the LECS via the Automatic ELAN Name. This field is not displayed if the actual name of the ELAN matches the name manually entered when the ELAN driver was configured.

7.3.5.8 Adapter Info... Button

Click this button to toggle the display to show the Adapter Information window. This window presents the information for the adapter associated with the highlighted VLAN.

7.4 Using the Adapter Information Window

The Adapter Information window, shown in Figure 7.7, displays general adapter information and data statistics for the adapter connection. The display is opened by clicking the Adapter Info button on the VLAN Information window, or selecting Adapter Info in the Windows menu.

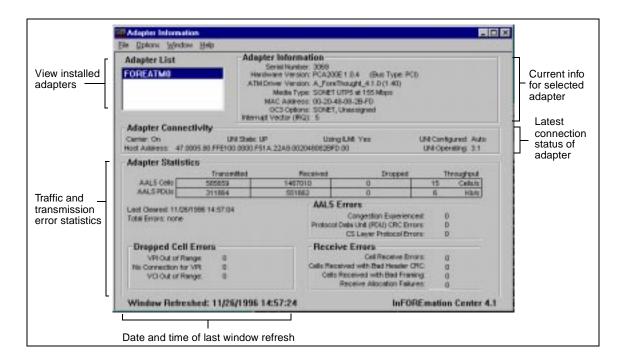


Figure 7.7 - Adapter Information Window

Refer to Table 7.2 for references to information on the Adapter Information Window.

Table 7.2 - Viewing the Adapter Information Window

For a description of	Refer to
Adapter information	"Adapter List Table" on page 7-13 "Adapter Information Table" on page 7-13
Connectivity information	"Adapter Connectivity Table" on page 7-15
Statistical information	"Adapter Statistics Table" on page 7-16

7.4.1 Adapter List Table

This table lists the FORE adapters currently installed in the machine and their corresponding unit numbers.

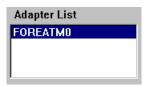


Figure 7.8 - Adapter List Portion of Adapter Information Window

7.4.2 Adapter Information Table

This table displays general information about the adapter specified in the Adapter List field. This information is automatically recorded in this field when the system is booted up.

```
Adapter Information
Serial Number: 3069
Hardware Version: PCA200E 1.0.4 (Bus Type: PCI)
ATM Driver Version: A_ForeThought_4.1.0 (1.40)
Media Type: SONET UTP5 at 155 Mbps
MAC Address: 00-20-48-08-2B-FD
OC3 Options: SONET, Unassigned
Interrupt Vector (IRQ): 5
```

Figure 7.9 - Adapter Information Portion of Adapter Information Window

Serial Number	Indicates the adapter card's encoded serial number. This number is also stencilled on its face.
Hardware Version	Indicates the adapter card's name and model and the bus type used by the adapter.
ATM Driver Version	Indicates the driver version number and build number. For the current release, the version is to 4.1.0.
Media Type	Indicates the physical media or cable type that connects the adapter to the switch. Several types exist.
MAC Address	Indicates the MAC address of the driver.

OC3 Options

Indicates the Framing Type and Empty Cell Insertion options, if an OC3 adapter is used. The field string has four possibilities: SONET, Unassigned; SONET, Idle; SDH, Unassigned; or SDH, Idle.

SONET and SDH indicate the possible framing types.

Unassigned indicates that the adapter inserts unassigned cells when the cells are empty. This is the ATM Forum and ANSI standard.

Idle indicates that the adapter inserts idle cells when the cells are empty. This is the ITU-T standard.

Typically, SONET, Unassigned is used in the United States and SDH, Idle is used in Europe.

Interrupt Vector (IRQ)

Indicates the interrupt request (IRQ) used by this adapter. This value is manually or automatically set by the PCI configuration utility when the adapter is installed.

7.4.3 Adapter Connectivity Table

This table displays general host connectivity information including the machine's connection status, its ATM address, and the configuration method.

Adapter Connectivity

Carrier: On UNI State: UP Using ILMI: Yes UNI Configured: Auto
Host Address: 47.0005.80.FFE100.0000.F51A.22A9.002048082BFD.00 UNI Operating: 3.1

Figure 7.10 - Adapter Connectivity Portion of Adapter Information Window

Carrier indicates that the host is successfully communicating with the network and is physically installed. Off indicates that the host is not communicating with the network and that the physical connection should be checked. **UNI State** Up indicates that UNI is operating and has established a connection with the switch. Down indicates it has not. Yes indicates that the host is configured to use ILMI. **Using ILMI** No means that it is not. **UNI Configured** Indicates what version of UNI the adapter driver was configured to use, 3.0, 3.1 or Auto to indicate that ILMI should automatically determine the UNI version to use. The ATM address of the host. If ILMI has not found Host Address it, the field will read Unknown (attempting to register) until it is located. **UNI Operating** Either 3.0 or 3.1 if the UNI version is known: Auto if ILMI is currently determining which version to use.

7.4.4 Adapter Statistics Table

This table displays statistical information for ATM traffic and transmission errors.

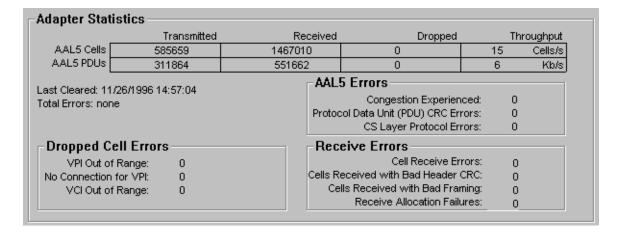


Figure 7.11 - Adapter Statistics Portion of Adapter Information Window

The statistical information includes cells and packet data units (PDUs):

- Transmitted
- Received
- Dropped
- Throughput (Kb/s)

Error statistics are broken down into three categories:

- AAL5
- · Dropped Cell
- Receive

AAL5 Errors:

- Congestion Experienced Traffic Overflow
- PDU CRC Errors Data Error Checking
- CS Layer Protocol Errors PDU errors

Dropped Cell Errors:

- VPI Out of Range Drops
- No Connection for VPI Drops
- VCI Out of Range Drops

Receive Errors:

- · Cells Received with Bad Header
- Cells Received with Bad Framing
- Small Buffer Allocation Failures
- Large Buffer Allocation Failures

7.5 Using the Refresh Options

The InFOREmation Center's Refresh Options allow you to set refresh intervals, implement immediate data refreshes, and clear statistical information at any time. These options are accessed through the Options menu.

7.5.1 Setting Refresh Intervals

The Set Refresh Interval dialog, shown in Figure 7.12, allows you to determine how often the application automatically polls the driver to update its displayed information, as well as the automatic refreshes that take place when you select list items in the windows.

To set the Refresh Intervals:

1. Select the **Set Refresh Interval...** menu option from the Options menu. The Set Refresh Intervals dialog box is displayed, as shown in Figure 4.4.

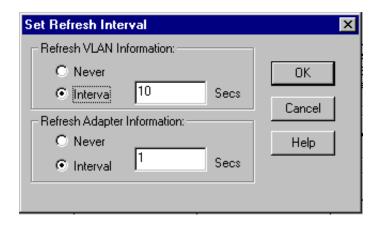


Figure 7.12 - Set Refresh Interval Dialog Box

- 2. Change the interval as desired for either or both types of information. The interval cannot be set to zero.
- 3. Click OK to implement the settings or Cancel to withdraw the changes and revert back to the original settings.



You may choose to not refresh one or both windows by selecting the appropriate Never option.

7.5.2 Refresh VLAN/Adapter Info Now

The Refresh VLAN Info Now and Refresh Adapter Info Now menu options immediately update the display, as opposed to waiting for the refresh interval as described in the previous section.

To refresh the currently displayed window, select the Refresh VLAN Info Now or Refresh Adapter Info Now option from the Options menu.

7.5.3 Zero Statistics

The Zero Statistics menu option allows you to clear the statistical information displayed in the Adapter Statistics window whenever desired. This menu option may be selected only when the Adapter Information window is displayed on-screen.

To clear adapter statistics:

- 1. Select the Zero Statistics menu option from the Options menu.
- 2. Release the mouse button. The adapter statistics are cleared.



The date and time the adapter statistics were last cleared are displayed in the Last Cleared field on the Adapter Information window. If they have never been cleared, Never cleared is displayed in this field.

7.6 Adding a Classical IP PVC

You can use the InFOREmation Center utility to add a PVC connection via an IP Over ATM (RFC 1577). In this manually configured connection, you must specify the VPI and VCI of the connection, or specify the IP address of the destination host.

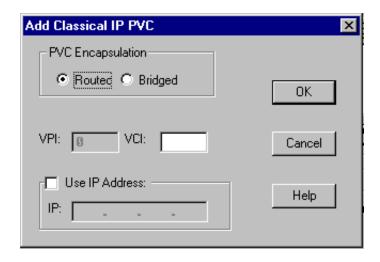


Figure 7.13 - Add Classical IP PVC Dialog Box

APPENDIX A LED Indicators

This appendix shows the location of and gives a description of the LED indicators on the faceplate of the adapter adjacent to the cable connectors.

A.1 LED Locations

The figures below show the appearance of the end plate for ST, SC, and UTP connectors. Note that the *ForeRunnerLE* 25Mbps adapters are available with UTP connectors only.

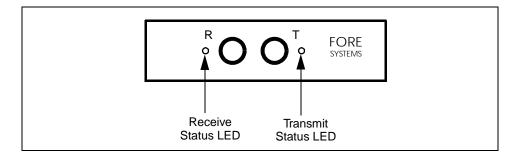


Figure A.1 - ST Connector End Plate Configuration

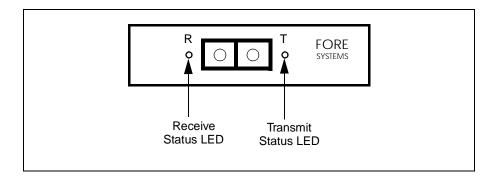


Figure A.2 - SC Connector End Plate Configuration

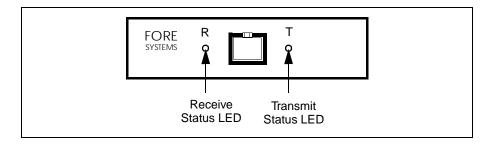


Figure A.3 - UTP Connector End Plate Configuration

A.2 LED Descriptions

The meanings of the LED indicators are described in Table A.2, "SC Connector End Plate Configuration," on page A-1 and Table A.2, "Receive LED," on page A-2.

Table A.1 - Transmit LED

LED Color	Meaning
green	Transmitting data
off	Idle
yellow	SONET alarm condition declared (indicates trouble with the receiving device)

Table A.2 - Receive LED

LED Color	Meaning
green	Receiving data
off	Idle
red	No carrier
yellow	No carrier (ForeRunnerLE 155)

Novell NetWare Network Troubleshooting

B.1 Introduction

This appendix describes procedures for troubleshooting a FORE driver for a PCA adapter that is running with the Novell LEC in the NetWare Server network operating system environment.

B.2 Troubleshooting Questions

If your workstation is unable to communicate with another workstation, review the following sections to check for possible solutions.

B.2.1 Is there an interrupt conflict with the adapter?

An interrupt conflict may exist if the adapter and another device (such as a mouse or sound card) are assigned the same IRQs.

How to check -

Run the PCI slot configuration utility for your PC and check the IRQ assignments.

Possible solutions -

To minimize potential conflicts, resources used by other devices cards or software can be manually entered into the PCI configuration database using the PCI slot configuration utility for your PC. Once entered, this data should be "locked" so another piece of software will not change the values stored for any PCI cards. When used properly, PCI configuration software automatically configures FORE cards correctly.

You can set the FORE adapter interrupt to 5, 10, 11, or 12. The default value is 5.

B.2.2 Is the adapter receiving a carrier signal?

If the adapter is not receiving a carrier signal, it is physically disconnected from the network.

How to check -

There are two ways to check this. One method uses the MONITOR utility:

- 1. Load the MONITOR.NLM module.
- 2. Select LAN/WAN information from Available Options.
- 3. Select the FORENP2E adapter from the list.
- 4. The last entry is for Carrier. A value of 1 indicates that carrier is on.

The other method is to look at the faceplate of the adapter card in the machine. If the receive LED is red, the adapter is not receiving a carrier signal. (The faceplates and LEDs are described in Appendix A.)

Possible solution - If there is no carrier, plug in or replace your fiber/cable as appropriate. Check that the receive and transmit connectors are attached to the correct ports.

B.2.3 Is the adapter plugged into the correct port on your switch?

The media type used by the adapter (SONET, OC-3, UTP) must match that of the port into which it plugs in the switch.

Possible solution - Contact your system administrator for switch information, if appropriate. Verify that the adapter media matches that of the network module it plugs into.

B.2.4 Are the adapter drivers loaded?

An instance of the Novell ATMELEC or ATMTRLEC driver must be loaded for each ELAN to which you are connecting, and an instance of the FORENP2E driver for each PCA-200EPC you have installed.

How to check -

- 1. At the NetWare console, type modules.
- 2. In the list of modules, make sure that you have ATMELEC or ATMTRLEC and at least one FORENP2E adapter driver loaded.

Possible solution - If the required modules are not loaded, load them as necessary, either manually or by adding the LOAD commands to the AUTOEXEC.NCF file and restarting the server.

B.2.5 Is the adapter receiving and transmitting cells?

How to check -

- Load the MONITOR.NLM module.
- 2. Select LAN/WAN information from Available Options.
- 3. Select the FORENP2E adapter from the list.
- 4. Review the Connection Manager statistics.

Possible solution - If cells are not being transmitted or received, recheck that the adapter is plugged into the correct media type on the switch and that the correct FORE modules are loaded. If these are all correct, it is possible you have a hardware problem. Contact FORE Technical Support.

B.2.6 Has the adapter connected to the desired ELAN?

How to check -

1. Issue the command (for Ethernet ELANs):

LOAD ATMELEC STATUS

or, for a Token Ring ELAN:

LOAD ATMTRLEC STATUS

2. If the LEC STATE is not LEC_OPERATIONAL, you may have misconfigured the driver or there may be a problem with the LANE services on the network.

Possible solution - Check that any unavailable addresses are specified correctly in the LOAD ATMELEC or LOAD ATMTRLEC command in the AUTOEXEC.NCF file. If they are specified correctly, contact your system administrator or refer to the documentation for the platform on which the LANE Emulation services are running.

B.2.7 Is the adapter using the correct frame type?

All hosts on the ELAN must have the same frame type.

How to check -

- 1. Load the MONITOR.NLM module.
- 2. Select LAN/WAN information from Available Options.
- 3. Select the ATMELEC or ATMTRLEC adapter from the list.
- 4. Are you transmitting or receiving packets?

Possible solution - If your workstation is not transmitting or receiving packets, check the **LOAD ATMELEC** or **LOAD ATMELEC** command in the AUTOEXEC.NCF file. The FRAME= parameter must specify the same frame type as all other hosts on the ELAN.

B.2.8 Is there a static NSAP route for the adapter on the switch?

If you're not using ILMI, the system administrator must set up a static NSAP route for the adapter on the switch.

How to check - Contact your system administrator for switch information.

Possible solution - Configure the switch as required.

Table B.1 - Summary of Troubleshooting Questions

Checklist Items	How to Check	Possible Solutions
Is adapter receiving carrier?	Load MONITOR . NLM. Check if carrier is indicated.	Check hardware connections. Make sure transmit/receive connectors are in correct plugs.
Is adapter attached to correct media type on switch?	Check media type of adapter and compare with media type on switch.	
Is ATMELEC or ATMTRLEC loaded for the adapter?	Issue modules command. Check if appropriate modules (ATMELEC or ATMTRLEC) are loaded.	
Is adapter transmitting and receiving cells?	Load MONITOR.NLM. Check AAL5 statistics.	Recheck first three items in checklist. Possible adapter hardware problem.
Is adapter connected to ELAN?	Load ATMELEC STATUS or ATMTRLEC STATUS. Check status of LEC and the LES, BUS, and LECS.	Sary.
Is adapter processing the correct frame type?	Load MONITOR . NLM. Check packet statistics.	Edit the frame types bound to the ATMELEC or ATMTRLEC drivers in AUTOEXEC.NCF.
Does adapter have NSAP route on switch (if ILMI is not being used)?		

B.3 For More Information

Table B.2 lists other places in this manual that may help you in troubleshooting.

Table B.2 - Information Sources

For Information About	Refer To	
Adapter checklist	"Pre-Installation Checklist" on page 3-2 "Multiple Adapters Worksheet" on page 3-3	
ATM addresses	"How to Specify an ATM Address" on page 3-4	
Contacting FORE Systems "Technical Support" on page iii of Preface Technical Support		
LAN Emulation overview	"Overview of LAN Emulation" on page 1-2	



Network Troubleshooting for Windows NT and Windows 95

C.1 Introduction

This appendix describes procedures for troubleshooting the FORE driver in the Windows NT and Windows 95 environments.

C.2 Troubleshooting Questions

If your workstation is unable to communicate with another workstation, review the following sections to check for possible solutions.

C.2.1 Is there an interrupt conflict with the adapter?

An interrupt conflict may exist if the adapter and another device (such as a mouse or sound card) are assigned the same IRQs.

How to check -

Run the PCI slot configuration utility for your PC and check the IRQ assignments.

Possible solutions -

To minimize potential conflicts, resources used by other devices cards or software can be manually entered into the PCI configuration database using the PCI slot configuration utility for your PC. Once entered, this data should be "locked" so another piece of software will not change the values stored for any PCI cards. When used properly, PCI configuration software automatically configures FORE cards correctly.

C.2.2 Is the adapter receiving a carrier signal?

If the adapter is not receiving a carrier signal, it is physically disconnected from the network.

How to check -

There are two ways to check this. One method uses the InFOREmation Center utility:

- 1. Double-click on InfOREmation Center in the Control Panel.
- 2. Select Adapter Information in the Window menu.
- 3. The Adapter Connectivity portion of the window should include the message Carrier: ON.

The other method is to look at the faceplate of the adapter card in the machine. If receive LED is showing a red light, the adapter is not receiving a carrier signal.

Possible solution - If there is no carrier, plug in or replace your fiber/cable as appropriate. Check that the receive and transmit connectors are attached to the correct ports.

C.2.3 Is the adapter plugged into the correct port on your switch?

The media type used by the adapter (SONET, OC-3, UTP) must match that of the port into which it plugs in the switch.

How to check -

- 1. Double-click on InfOREmation Center in the Control Panel.
- 2. Select Adapter Information in the Window menu.
- 3. The Media Type parameter should match the type of port to which the adapter is connected on the switch.

Possible solution - Contact your system administrator for switch information, if appropriate.

C.2.4 Are the adapter drivers loaded?

An instance of the *ForeRunner* ELAN driver must be loaded for each ELAN to which you are connecting, and an instance of the *ForeRunner* driver for each adapter card you have installed.

How to check -

- 1. Double-click on the Network control panel.
- 2. Make sure that at least one ForeRunner ATM Adapter and one ForeRunner ELAN Adapter driver appear in the Installed Adapter Cards.

Possible solution - If the required drivers are not loaded, add them as necessary, using the procedures in the driver installation chapter.

C.2.5 Is the adapter receiving and transmitting cells?

How to check -

- 1. Double-click on InfOREmation Center in the Control Panel.
- 2. In the AAL Statistics that are displayed, make sure there are AAL5 cells being transmitted and received.

Possible solution - If cells are not being transmitted or received, recheck that the adapter is plugged into the correct media type on the switch and that the correct FORE drivers are loaded. If these are all correct, and you have a *ForeRunnerLE* adapter, proceed to run the adapter diagnostics, as described in "Running LE Adapter Diagnostics" on page E-1. Otherwise, contact FORE Technical Support.

C.2.6 Has the adapter connected to the desired Emulated LAN?

This applies if you are using the FORE ELAN driver to connect to an emulated Ethernet or Token Ring LAN.

How to check -

- 1. Double-click on InfOREmation Center in the Control Panel.
- 2. Check that the desired ELAN appears in the list of Enabled FORE VLANS. If it is, select it. If it is not, you must install an ELAN driver for the desired ELAN.
- 3. Check the State field. Review the possible values for this field, listed in "Possible Values of the ELAN State Field" on page D-1.

C.2.7 Has the adapter connected to the desired Classical IP LIS?

This applies if you are using the FORE IP Over ATM driver to connect to an emulated to a Logical IP Subnet (LIS), as defined by Classical IP (RFC 1577).

How to check -

- 1. Double-click on InfOREmation Center in the Control Panel.
- 2. Check that the desired LIS appears in the list of Enabled FORE VLANs. If it is, select it. If it is not, you must installed an IP Over ATM driver for the desired LIS.

C.2.8 Is there a static NSAP route for the adapter on the switch?

If you're not using ILMI, the system administrator must set up a static NSAP route for the adapter on the switch.

How to check - Contact your system administrator for switch information.

Possible solution - Configure the switch as required.

C.2.9 Is the adapter using the correct UNI version?

The adapter driver must be using the same version of the UNI protocol as the switch to which it is connected, either UNI 3.1 or UNI 3.0. If you are using ILMI to determine the UNI version (which is the default driver setting), and ILMI is running, the adapter's UNI version should be correct. If you aren't using ILMI, the driver's default setting is UNI 3.1. If the switch is using UNI 3.0, you must manually specify that the driver use UNI 3.0 by specifying the UNI 3.0 option when configuring the driver.

How to check -

- Double-click on InfOREmation Center in the Control Panel.
- 2. Click on the Adapter Info... button.
- 3. The UNI Configured field indicates which version of UNI the driver is configured to use. (If it indicates Auto, ILMI has determined the UNI version, which is indicated in the UNI Operating field.)
- 4. Contact you system administrator to compare this version with the version running on the switch.

Possible solution - Configure the driver to use the correct UNI version, as described in the driver installation chapter.

C.3 For More Information

Table C.1 lists other places in this manual that may help you in troubleshooting.

Table C.1 - Information Sources

For Information About	Refer To
LAN Emulation	"Overview of LAN Emulation" on page 1-2
Classical IP	"Overview of Classical IP (Windows 95 and NT)" on page 1-7
The InFOREmation Center Application	"Viewing ATM Statistics in Windows NT and Windows 95" on page 7-1
Adapter checklist	"Multiple Adapters Worksheet" on page 3-3 "Pre-Installation Checklist" on page 3-2
ATM addresses	"How to Specify an ATM Address" on page 3-4
Contacting FORE Systems Technical Support	"Technical Support" on page iii of the Preface

C.4 Troubleshooting Checklist

Table C.2 provides a summary checklist of the troubleshooting questions.

Table C.2 - Summary of Troubleshooting Questions

Checklist Items	How to Check	Possible Solutions
Is adapter receiving carrier?	Start InfOREmation Center. Check if carrier is indicated.	Check hardware connections. Make sure transmit/receive connectors are in correct plugs.
Is adapter attached to correct media type on switch?	Start InfOREmation Center. Check media type of adapter and compare with media type on switch.	Contact system administrator and use compatible media.
Are the drivers loaded for the adapter?	Check Network control panel. Check if appropriate drivers (ForeRunner ATM Adapter and ForeRunner ELAN Adapter) are loaded.	Add the drivers as necessary.
Is adapter transmitting and receiving cells?	Start InFOREmation Center. Check AAL5 statistics.	Recheck first three items in checklist. Possible adapter hardware problem.
Is adapter connected to ELAN? (if using ELAN driver)	Start InFOREmation Center. Check Enabled FORE VLANs and ELAN State fields.	Change ELAN driver configuration, if necessary. Contact system administrator and check status of LANE services if necessary.
Is adapter connected to LIS? (if using IP Over ATM driver)	Start InFOREmation Center. Check Enabled FORE VLANs.	Change IP Over ATM driver configuration, if necessary. Contact system administrator and check status of ARP server if necessary.
Does adapter have NSAP route on switch (if ILMI is not being used)?	Contact system administrator to review switch configuration.	Edit switch configuration if necessary.

C.5 Collecting Diagnostic Information (Windows NT)

This section briefly describes key information that should be collected in the event of a Windows NT Operating Systems failure. This information does not apply to Windows 95. Providing the information described below is critical to the timely identification and diagnosis of any problems related to the ATM adapter software.

Windows NT Systems can totally fail in two different ways:

- 1. System Hang A system hang results when a major problem within the Operating System or one of its kernel mode components goes undetected. The system ceases to be responsive, and fails to accomplish any useful work. Sometimes, but not always, the display is lost (rendering the system console screen totally black). As a result, system hangs are often referred to as *Black Screens*.
 - There is little or no useful data that can be gathered after a system hang when the system is configured for ordinary use. However, once your system has been rebooted, be sure to collect the WinMSD information, as described in Section C.5.2, on your system.
- 2. System Halt The Operating System displays a set of diagnostic information on the system console and halts its own execution. This information is displayed in white characters on a blue screen. As a result, Windows NT crashes are often referred to as *Blue Screens*.
 - Unlike a system hang, there is much more information that can be gathered when a system halts. The following section describes the data that should be collected after the system halts.

C.5.1 Blue Screen Data

When the system halts, it is vital that as much information as possible be preserved from the system console display. The precise format of the information varies, depending on the type of crash and version of the operating system in use. Starting with Windows NT 3.5, it is possible to configure the system to save any blue screen diagnostic messages to a file automatically.

You can enable this option by checking the Write debugging information file to: <file> option in the Recovery dialog box. You can specify the path for the file. The Recovery dialog box is invoked by clicking the Recovery... button in the System dialog box, from the Control Panel program group.



You have to be the administrator of the PC to use the above feature.

If you are running Windows NT 3.5 or later, ensure that the system is configured to capture any crash information that is generated.

C.5.2 Using WinMSD

In addition to the Blue Screen data you have collected above, you also need data about your system and its hardware. This information is displayed in detail by the **WINMSD** utility.

Once your system is restarted, wait for it to resume normal operation. Start any devices and services that were active at the time of the crash. Then run the WINMSD program (typically located in the \winnt35\system32 directory). Use WINMSD to create a report, and save this report to a file. In Release 3.5 of NT, select the Save Report... option from the File menu.

WINMSD can be invoked from the Program Manager by selecting Run... from the File menu and executing the following command:

WINMSD

C.6 Before Calling Support

Collect all the information described above and have it ready prior to calling FORE Technical Support. They will request specific information from the **WINMSD** report, and from the blue screen data that you have collected. If you have access to the Internet, sending electronic mail to FORE Technical Support with all the information you have collected is recommended.



Possible Values of the ELAN State Field

The following messages can appear in the ELAN State field to describe the status of the host when it is attempting to perform an action:

- Waiting for LECS connection
- Waiting for ATM address
- Trying LECS request on PVC 17
- Waiting for LECS response on SVC
- Waiting for LES connection
- Waiting for LES JOIN response
- Waiting for BUS connection
- Waiting for BUS PMP connection

When the host has successfully connected to an ELAN, the Connected to all LE servers message is displayed.

The messages below can appear in the ELAN State field to indicate that the host encountered a possible problem.

Waiting to retry after ATM address changed – Your machine's ATM address changed, and the driver is restarting the ELAN. This shouldn't happen repeatedly. If it *does* happen repeatedly, it probably indicates an ILMI problem, in which ILMI is continually registering and unregistering your machine's ATM address.

Possible solution - Contact your system administrator.

Waiting to retry after LECS failed to respond - The LECS failed to respond to a request in a reasonable amount of time. Probably the machine running the LECS has become unresponsive.

Possible solution - Contact your system administrator to check the status of the LECS.

Waiting to retry after LECS and client version mismatch discovered - The LECS and this client are running incompatible versions of the LAN Emulation software.

Possible Solution - Contact your system administrator and install the latest versions of the LANE software on the LECS and the client.

Waiting to retry after LECS told us this is an Ethernet ELAN - The LECS has indicated that this is an Ethernet ELAN and the client is configured as an emulated Token Ring driver rather than Ethernet.

Possible Solution - Reconfigure the ELAN driver as an Ethernet driver rather than a Token Ring driver.

Waiting to retry after LECS told us this is a Token-Ring ELAN - The LECS has indicated that this is an Token Ring ELAN and the client is configured as an emulated Ethernet driver rather than Token Ring.

Possible Solution - Reconfigure the ELAN driver as an Token Ring driver rather than an Ethernet driver.

Waiting to retry after LECS told us this is a 1516 byte ELAN - The LECS has indicated that this ELAN is configured with a 1516 byte Frame size, which this client does not match.

Possible Solution - Reconfigure the ELAN driver with a Frame Size of 1516.

Waiting to retry after LECS told us this is a 4544 byte ELAN - The LECS has indicated that this ELAN is configured with a 4544 byte Frame size, which this client does not match.

Possible Solution - Reconfigure the ELAN driver with a Frame Size of 4544.

Waiting to retry after LECS told us this is a 9234 byte ELAN - The LECS has indicated that this ELAN is configured with a 9234 byte Frame size, which this client does not match.

Possible Solution - Reconfigure the ELAN driver with a Frame Size of 9234.

Waiting to retry after LECS told us this is a 18190 byte ELAN - The LECS has indicated that this ELAN is configured with a 18190 byte Frame size, which this client does not match.

Possible Solution - Reconfigure the ELAN driver with a Frame Size of 18190.

Waiting to retry after LECS rejected our request parameters - One of the situations described in the six previous messages occurred (mismatch between LECS and this client in ELAN type or Frame Size). However, the LECS did not return enough information to determine which situation occurred.

Possible Solution - Contact your system administrator to determine the correct ELAN type and Frame Size for this ELAN and reconfigure the ELAN driver as necessary.

Waiting to retry after LECS ran out of resources - The LECS ran out of resources (probably memory or VCs).

Possible Solution - Contact your system administrator to check the status of the LECS.

Waiting to retry after LECS denied us access for security reasons - The LECS did not permit this client to join the ELAN due to security reasons.

Possible Solution - Contact your system administrator to get access to the ELAN.

Waiting to retry after LECS told us our requestor-id is invalid - The LECS did not accept this client's requestor ID.

Possible Solution - Contact the vendor of the LECS software to report the problem.

Waiting to retry after LECS told us our LAN destination is invalid - The LECS did not accept this client's LAN destination.

Possible Solution - Contact the vendor of the LECS software to report the problem.

Waiting to retry after LECS told us our ATM address format is invalid - The LECS did not accept the ATM address format used by this client.

Possible Solution - Contact the vendor of the LECS software to report the problem.

Waiting to retry after LECS failed to recognize us - The LECS failed to recognize this client.

Possible Solution - Contact your system administrator and report the problem.

Waiting to retry after LECS refused to service us - The LECS refused to service this client.

Possible Solution - Contact your system administrator and report the problem.

Waiting to retry after could not decode LECS response - This client could not decode the response it received from the LECS.

Possible Solution - Contact the vendor of the LECS software to report the problem.

Waiting to retry after LECS failed to find ELAN - The LECS didn't recognize the ELAN name. The ELAN name was probably typed incorrectly, or the LECS database has been corrupted.

Possible Solution -

- Check that the name you entered for the ELAN is correct.
- Contact your system administrator to check the status of the LECS.

Waiting to retry after LES address changed - The LECS database indicates a new LES address for the ELAN, so the ELAN is being shutdown and restarted to connect to the new LES. This shouldn't happen repeatedly.

Possible Solution - If this occurs repeatedly, contact your system administrator to check the status of the LES and LECS.

Waiting to retry after LISTEN request failed - An attempt to setup for receiving incoming ATM connections failed. This is an internal error.

Possible Solution - Contact FORE Technical Support.

 $\textbf{Waiting to retry after SDU (memory) allocation failed} \cdot \text{Out of kernel memory}.$

Possible Solution - Reboot your machine and try again.

Waiting to retry after ran out of resources (to LES) - Out of ATM resources, probably at the switch, but perhaps at the client.

Possible Solution - Reboot your machine and try again.

Waiting to retry after buffer alloc (JOIN) failed - Out of kernel memory on the host machine.

Possible solution - Reboot your machine and try again.

Waiting to retry after LES connection dropped - The LES has become unavailable.

Possible solution - Contact your system administrator to check the status of the LES.

Waiting to retry after failed to connect to LES - The LES doesn't appear to be running, or, if manually configured, the LES's ATM address may have been typed incorrectly.

Possible solution - Check that you have correctly entered the ATM address of the LES.

Waiting to retry after JOIN request timed out - The machine running the LES is not responding to a JOIN request.

Possible solution - Contact your system administrator to check the status of the LES.

Waiting to retry after LES and client version mismatch discovered - The LES and this client are running incompatible versions of the LAN emulation software.

Possible Solution - Contact your system administrator and install the latest versions of the LANE software on the LES and the client.

Waiting to retry after LES told us this is an Ethernet ELAN - The LES indicated that this is an Ethernet ELAN and this client is configured as a Token Ring ELAN.

Possible Solution - Reconfigure the ELAN driver as an Ethernet driver rather than a Token Ring driver.

Waiting to retry after LES told us this is a Token-Ring ELAN - The LES has indicated that this is an Token Ring ELAN and this client is configured as a Ethernet ELAN.

Possible Solution - Reconfigure the ELAN driver as an Token Ring driver rather than a Ethernet driver.

Waiting to retry after LES told us this is a 1516 byte ELAN - The LES has indicated that this ELAN is configured with a 1516 byte Frame size, which this client does not match.

Possible Solution - Reconfigure the ELAN driver with a Frame Size of 1516.

Waiting to retry after LES told us this is a 4544 byte ELAN - The LES has indicated that this ELAN is configured with a 4544 byte Frame size, which this client does not match.

Possible Solution - Reconfigure the ELAN driver with a Frame Size of 4544.

Waiting to retry after LES told us this is a 9234 byte ELAN - The LES has indicated that this ELAN is configured with a 9234 byte Frame size, which this client does not match.

Possible Solution - Reconfigure the ELAN driver with a Frame Size of 9234.

Waiting to retry after LES told us this is a 18190 byte ELAN - The LES has indicated that this ELAN is configured with a 18190 byte Frame size, which this client does not match.

Possible Solution - Reconfigure the ELAN driver with a Frame Size of 18190.

Waiting to retry after LES rejected our request parameters - One of the situations described in the six previous messages occurred (mismatch between LES and this client in ELAN type or Frame Size). However, the LES did not return enough information to determine which situation occurred.

Possible Solution - Contact your system administrator to determine the correct ELAN type and Frame Size for this ELAN and reconfigure the ELAN driver as necessary.

Waiting to retry after LES found duplicate LAN destination registered - Another client has registered the same LAN destination with the LES as this client.

Possible Solution - Contact your system administrator to eliminate all duplicate LAN destinations in the ELAN.

Waiting to retry after LES found duplicate ATM address registered - Another client has registered the same ATM address with the LES as this client.

Possible Solution - Contact your system administrator to eliminate all duplicate ATM addresses in the ELAN.

Waiting to retry after LES ran out of resources - The LES ran out of resources (probably memory or VCs).

Possible Solution - Contact your system administrator to check the status of the LES.

Waiting to retry after LES denied us access for security reasons - The LES did not permit this client to join the ELAN due to security reasons.

Possible Solution - Contact your system administrator to get access to the ELAN.

Waiting to retry after LES told us our requestor-id is invalid - The LES did not accept this client's requestor ID.

Possible Solution - Contact the vendor of the LES software to report the problem.

Waiting to retry after LES told us our LAN destination is invalid - The LES did not accept this client's LAN destination.

Possible Solution - Contact the vendor of the LES software to report the problem.

Waiting to retry after LES told us our ATM address format is invalid - The LES did not accept the ATM address format used by this client.

Possible Solution - Contact the vendor of the LES software to report the problem.

Waiting to retry after could not decode LES response - This client could not decode the response it received from the LES.

Possible Solution - Contact the vendor of the LES software to report the problem.

Waiting to retry after LE_ARP for BUS failed - The LES may be configured incorrectly, or, more likely, the machine running the LES has become unresponsive.

Possible solution - Contact your system administrator to check the status of the LES.

Waiting to retry after ran out of resources (to BUS) - The host machine or the switch is out of VC resources.

Possible solution - Reboot the machine and try again.

Waiting to retry after BUS connection dropped - The BUS recently became unavailable.

Possible solution - Contact your system administrator to check the status of the BUS.

Waiting to retry after failed to connect to BUS - The BUS has become unavailable or the LES was started with the wrong address for the BUS.

Possible solution - Contact your system administrator to check the status of the LES and BUS.



Running LE Adapter Diagnostics

The *ForeRunnerLE* Diagnostics utility can be used with the *ForeRunnerLE* adapters to display adapter information and exercises the adapter's components, helping to distinguish between hardware problems and software problems. If the adapter does not function properly, yet passes the low-level tests, then please refer to the troubleshooting appendix for your operating system. If the diagnostics utility does show problems, contact FORE Systems' Technical Support, as described in the Support option of the diagnostics utility or as described in "Technical Support" on page iii of the Preface. Be prepared to describe which tests the adapter failed.

To run the diagnostics utility, you must be in DOS. The adapter must be disconnected from the network when you run the low-level tests.

E.1 Features

The diagnostics utility provides:

- Information on the current state of the adapter.
- Information about adapter hardware version and media type.
- A low-level test suite. These tests require that you detach the workstation from the network.
- The ability to log the diagnostics information to a log file.

E.2 Installing the Diagnostics Utility

To install the *ForeRunnerLE* diagnostics utility, copy the LEDIAG. EXE file from the \DIAGS directory of the *ForeRunnerLE* software CD to your hard drive.

E.3 Starting the Diagnostics Utility

After copying the diagnostics utility from the CD, you can run the utility from DOS.



The diagnostics utility must be started directly from DOS. It cannot be run from a DOS window in Windows NT or Windows 95 and cannot be run from an OS/2 window in OS/2.

Issue the following command at the DOS prompt to run the diagnostics utility:

lediag

If you have multiple *ForeRunnerLE* adapters installed in your machine, a menu displays, listing the last eight digits of each adapter's serial number. Select the adapter on which you want to run the diagnostics tests.

When started, the utility displays the following options in the main menu:

- 1. Display Adapter Information
- 2. Display Network Registers
- 3. Display PCI Registers
- 4. Low Level Tests
- 5. Toggle Test Logging: OFF
- 6. Support Information
- 7. Exit

These options are described in "Main Menu Options" on page E-3.

E.4 Displaying On-line Help

To display on-line help for an option, select that option by using the arrow keys or typing the number of the option, and then press <h>.

E.5 Main Menu Options

E.5.1 Displaying Adapter Information

To display information about this *ForeRunnerLE* adapter, select option 1, Display Adapter Information, from the main menu.

The diagnostics utility displays information similar to the following:

Product ID: ForeRunnerLE 25

Hardware Revision PROT

Serial Number APL-ADPLE2U-9610-2162800

Media Type: UTP 25

MAC Address: 00:23:48:11:28:9B

E.5.2 Displaying Network Registers

To display the contents of the network registers on the adapter, select option 2, Display Network Registers, from the main menu. This information can be valuable to Technical Support to determine the state of the network interface.

The register information is different for a 25 Mbps adapter and a 155 Mbps adapter. The diagnostics utility displays information similar to the following for a 25 MB adapter:

Master Control:0x09
Interrupt Status:0x33
Diagnostic Control:0x20
LED/HEC Status/Control:0x04
Low Byte Cntr: 0x00
High Byte Cntr:0x00
Cntr Read Select:0x00

The diagnostics utility displays information similar to the following for a 155MB adapter:

SUNI reg 0x00 : read=0x30; masked read=0x30 SUNI reg 0x01 : read=0x70; masked read=0x70 SUNI reg 0x02 : read=0x00; masked read=0x00 SUNI reg 0x04 : read=0x0f; masked read=0x0f

.

E.5.3 Displaying PCI Registers

To display the contents of the PCI registers, select option 3, Display PCI Registers, from the main menu.

The diagnostics utility displays information similar to the following:

Memory Mapped Address:	0x4000000
PCI Status Register:	0x0280
PCI Command Register:	0x0143
PCI Latency Timer:	0x00
Interrupt Line:	0x0a
Base Address Register Spa	ace:
Byte 0x010:	0x10
Byte 0x011:	0x11
Byte 0x012:	0x12
Byte 0x013:	0x13
Byte 0x014:	0x14
Byte 0x015:	0x15
Byte 0x016:	0x16
Byte 0x017:	0x17

E.5.4 Running Low Level Tests

To run low level tests on the adapter, select option 4, Low-level Tests, from the main menu. This option displays a menu of test options which allow you to test specific areas of the adapter through menu choices. To run these tests, the adapter must be disconnected from the network.

When you choose this option, a warning that you must disconnect the adapter from the network is displayed. The diagnostics utility then sets up the tests, which may take a moment.

E.5.4.1 The Low Level Tests

As each of these tests is run, the terminal displays a status message at various stages. If a test fails, a window appears with a brief description of the failure.

Select the appropriate option from the Low Level Test Menu:

- 1. SRAM Test Checks the status of the SRAM (Static Random Access Memory) on the adapter.
- 2. DMA Test Checks the DMA (Direct Memory Access) functions on the adapter.
- Network Tests (Internal) Checks the transmit/receive ability of the adapter.
- 4. **Network Tests (External)** Checks the transmit/receive ability of the adapter through a loopback cable. If you do not have a loopback cable attached to the adapter, this test will time-out and fail.



If you do not use a loopback cable to execute option 4, the low level diagnostic tests do not fully test the physical layer of the adapter.

- 5. All of the Above Performs all four of the above tests.
- 6. Return to Main Menu Return to the main menu of the diagnostics program.

E.5.4.2 Using a Loopback Cable

For the *ForeRunnerLE* 155 adapter with an SC connector, you can simply use a length of multimode fiber to connect the transmit port of the adapter to the receive port.

For the *ForeRunnerLE* 25 adapter, or a 155 with an RJ-45 connector, you must obtain a loopback connector from your cable vendor or can create your own, as described in "Creating an RJ-45 Loopback Connector" on page E-6.

E.5.4.3 Creating an RJ-45 Loopback Connector

To create a loopback connector, you must connect the transmit pins to the receive pins of an RJ-45 connector, as shown in Figure E.1. Connect the pins using the following guide:

- Pin 1 (transmit +) to pin 7 (receive +)
- Pin 2 (transmit -) to pin 8 (receive -)



The RJ-45 pinouts for ATM are different than the pinouts for an Ethernet RJ-45 connector. Be sure to use the correct pinouts, given here, when creating your loopback connector.

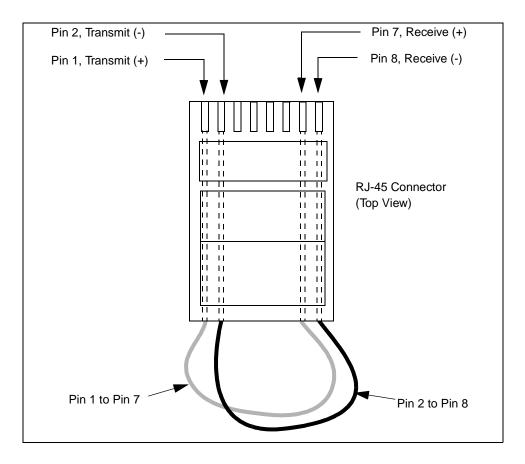


Figure E.1 - RJ-45 Loopback Connector

E.5.5 Logging Diagnostics Information

To begin logging the information displayed by the diagnostics utility, select option 5, Toggle Test Logging, from the main menu.

This option turns logging on and off. If you turn logging on, you are prompted to use the default log file, c:\atm.log. You also have the option of specifying a path and filename. The diagnostics utility then writes all information produced by the utility to the log file until you halt logging by selecting this menu option again or by exiting the diagnostics utility.

The log file is a simple text file that can be read with any text editor.

E.5.6 Contacting Technical Support

To display information about contacting FORE Systems Technical Support, select option 6, Support Information, from the main menu.

This option displays the address of FORE Systems, Inc. and lists the phone number and e-mail address for Technical Support.

E.5.7 Exiting the Diagnostics Utility

To exit the diagnostics utility, select option 7, **Exit**, from the main menu. Reboot the workstation after exiting to restore normal operation of the adapter.

Running LE Adapter Diagnostics

Using the FORE ATM Service Provider with WinSock 2

The FORE ATM Service Provider is a protocol stack that complies with the Windows Sockets 2 (WinSock 2) Service Provider Interface (SPI) specification. WinSock 2 allows an application to use the familiar socket interface to achieve simultaneous access to any number of installed transport protocols, including ATM. The FORE ATM Service Provider can be used for native ATM applications developed in WinSock 2.

WinSock 2 requires either Windows NT 4.0 or Windows 95 and can work only in a 32-bit environment.

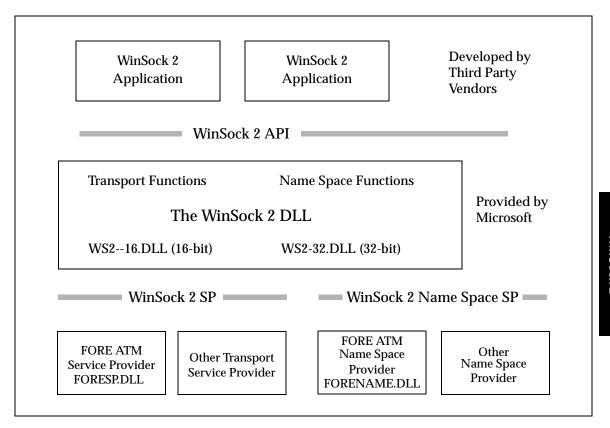


Figure F.1 - WinSock 2

To allow WinSock 2 to recognize the FORE ATM Service Provider, you must install the FORE ATM Service Provider with WinSock 2. The installation process registers the Service Provider with the WS2_32.Dll. To do this use the installation program, as described in "Installing and Upgrading the Service Provider" on page F-6. After the installation, a developer deals only with WinSock2. The Service Provider works only with FORE Systems' *ForeThought* 4.1 adapter drivers.

F.1 The FORE Name Space Provider

In addition to the Service Provider, FORE also provides a Name Space Provider. The Name Space Provider allows developers to use the name resolution and registration functions available in WinSock2 with the FORE Service Provider. An ATM application developed with the Name Space Provider can reference an ATMHOSTS file in the \%windir% directory, containing a list of ATM addresses and associated text names. An example ATMHOST file is included with the FORE Service Provider software, and the sample application code can be referred to for an example of Name Space Provider usage.



The ATMHOSTS file must not have a .TXT extension (or any extension). When you edit it, make sure that the editor does not add an extension.

The Name Space Provider can be installed and registered with WinSock at the same time as the Service Provider, as described in "Installing and Upgrading the Service Provider" on page F-6.

F.2 Getting Started: WinSock2 and the Service Provider

Because the FORE ATM Service Provider is integrated as a behind-the-scenes component of the WinSock 2 API, developers familiar with WinSock 2 should be able to use the Service Provider without great difficulty. This document is intended to point out information that applies to ATM in general, using the ATM extensions to WinSock 2, and the current status of the FORE ATM Service Provider.

The following sections describe where to find further, comprehensive information on Windows Sockets 2, and provide required information for developing applications with the FORE ATM Service Provider and Windows Sockets 2. Refer to "Brief Overview of ATM" on page F-10 for ATM concepts such as SVCs and PVCs.

F.2.1 Refer to the WinSock 2 Software Development Kit (SDK)

Intel and Microsoft provide the Windows Sockets 2 SDK to developers. As a WinSock 2 developer, you should reference the documentation in the SDK. Also, there are numerous World Wide Web sites devoted to development in WinSock. Among these are:

- http://www.stardust.com
- http://www.intel.com/ial/winsock2/index.htm
- http://www.sockets.com/
- http://www.winsock.com/wsresource/wsresrce.html

Many published reference books are also devoted to development in WinSock.



The WinSock 2 SDK is required only for Windows 95. The Winsock 2 support is built in to Windows NT 4.0.



The FORE ATM Service Provider works with the 1.6 version of the SDK (although the most recent version of the WS2ATM. H header file is required) or the 2.0 version of the SDK.

F.2.2 Summary of WinSock 2 Features

WinSock 2 expands the earlier WinSock interfaces and includes support for the following new features. This is a partial list of WinSock 2 features. For the complete list and description of the WinSock 2 API, refer to the WinSock 2 specifications and the WinSock 2 SDK.

- Multiple protocols including ATM. The WinSock 2 architecture is designed so that
 the WinSock interface can be used for simultaneous access to up to four different
 installed protocol stacks.
- Quality of Service (QoS). WinSock 2 provides mechanisms that allow applications
 to negotiate for the required quality of service, taking advantage of ATM's QoS
 capabilities.
- Multipoint and Multicast. WinSock 2 allows applications to take advantage of ATM point-to-multipoint capabilities.
- Overlapped I/O. WinSock 2 supports overlapped I/O and other features that can assist applications in performing Real-time Multimedia Communications.

F.2.3 ATM Extensions to the WinSock API

WinSock 2 includes ATM-specific extensions needed to support the native ATM services specified in the ATM Forum's User Network Interface (UNI) 3.0 or 3.1 specification.

- A new address family, AF_ATM, and a corresponding sockaddr structure, SOCKADDR_ATM, are defined.
- ATM point-to-multipoint and point-to-point connection setup and teardown are supported in WinSock 2.
- An ATM-specific QoS extension is also available.

For a complete description of the ATM extensions in WinSock 2, refer to the ATM-Specific Extensions annex of the WinSock 2 specifications.

F.2.4 Unsupported WinSock 2 Functions

This release of the FORE ATM Service Provider does *not* support the following WinSock 2 capabilities:

- Multiple adapters. The FORE ATM Service Provider currently supports only one FORE ATM adapter.
- Limited rate-shaping is supported on the PCA-200EPC adapter. Full CBR is supported on the *ForeRunnerLE* adapters.

F.2.4.1 VPI and VCI Limitations

Only VPI 0 is supported. Also, please note that VCI's 0 through 31 are reserved by the ATM Forum, and that the FORE drivers support a maximum of 1024 VCI's.

F.2.5 Files Included with the Service Provider

The FORE Service Provider files are available from the FORE Systems FTP site. Relevant files include:

- FORESP.DLL, the DLL file for the FORE Service Provider. There are different FORESP.DLL files for Windows 95 and Windows NT.
- FORENAME.DLL, the DLL file for the FORE Name Service Provider.
- WSATMDRV. VXD, a driver file used in Windows 95.
- WSATMDRV.SYS, a driver file used in Windows NT.

These files are installed, upgraded, or deleted by the setup utility described in "Installing and Upgrading the Service Provider" on page F-6.

The \WINSOCK2 directory also contains files for the Setup utility and sample files to aid in understanding the use of the FORE ATM service and name providers with WinSock 2.

F.3 Installing and Upgrading the Service Provider

Installation of the FORE ATM service and name provider requires the following steps:

- Check that you have the required WinSock 2 files in the correct directories on your machine.
- 2. Download the FORE service provider and name service provider files from the FORE FTP site.
- 3. Run the Setup utility to install the service provider and register it with your Win-Sock 2 files. Setup copies the relevant directories and files to the required locations on your hard drive and registers the service provider files with WinSock. The following sections describe these steps in detail.

To upgrade or un-install the service provider files, run the setup utility as described in "Running the Setup Utility".

F.3.1 Required WinSock 2 Files

You must have the Windows Sockets 2 SDK (version 1.6 or 2.0) installed on your machine. This SDK is included with Windows NT 4.0 but not with Windows 95. You must also ensure that the Windows Sockets 2 DLL (WS2_32.DLL) is installed in the correct directory on your machine:

- On Windows 95 WS2_32.DLL must be installed at %windir%\system directory.
- On Windows NT 4.0 WS2_32.DLL is installed on %SystemRoot%\system32 directory.

F.3.2 Running the Setup Utility

To install, upgrade, or delete the Service Provider and Name Space Provider, use the following procedure:

- 1. Run SETUP. EXE from the directory in which the FORE WinSock files reside.
 - a. Click on the Start button.
 - b. Select the Run... option.
 - c. Specify the directory path to the SETUP. EXE file, in the directory containing the files downloaded from the FORE FTP site.

- 2. Follow the instructions of the installation utility. You are given the following options, depending on what you want to do:
 - Install the Service and Name Provider on a machine for the first time.
 - Upgrade the Service and Name Provider on a machine on which an earlier version of the SPI has been installed.
 - Remove the Service and Name Provider.

When you have completed all steps, a message appears, indicating that the SPI has been installed, upgraded, or deleted.

F.4 Using the Service Provider

F.4.1 Recognizing the Service Provider in Your Application

FORESP.DLL must be registered with WS2_32.DLL, as described in "Installing and Upgrading the Service Provider" on page F-6. After the registration, WS2_32.DLL relies on the parameters of the API socket creation functions (socket() and WSASocket()) to determine which Service Provider to utilize. In the case of the socket() function, the WS2_32.DLL finds the first entry in the set of installed WSAPROTOCOL_INFO structs that matches the values supplied in the tuple formed by the (address family, socket type, protocol) parameters. To preserve backwards compatibility, the WinSock 2 DLL treats the value of zero for either address family or socket type as a wild card value. The value of zero for protocol is not considered a wild card value by the WinSock 2 DLL unless such behavior is indicated for a particular protocol by having the PFL_MATCHES_PROTOCOL_ZERO flag set in the WSAPROTOCOL_INFO struct.

For the WSASocket() function, if NULL is supplied for <code>lpProtocolInfo</code>, the behavior is exactly as just described for <code>socket()</code>. If a WSAPROTOCOL_INFO struct is referenced, however, the WinSock 2 DLL does not perform any matching function but immediately relays the socket creation request to the transport Service Provider associated with the indicated <code>WSAPROTOCOL_INFO</code> struct.

If an application developer wants to find out what protocols are installed, use the function <code>WSAEnumProtocols()</code>. This function will return all installed protocols' <code>WSAPROTOCOL_INFO</code> struct. Use this structure to choose the protocol he or she needs. In this sense, the Service Provider is not completely hidden.

You must install and register a Service Provider, otherwise the Service Provider will not be available. When a particular Service Provider is not installed, if an application uses the tuple formed by the (address family, socket type, protocol) parameters to demand this type of service (in our case, ATM Service Provider), another Service Provider of the same type will be chosen if it is available. Otherwise, WSASocket() and socket() will return error indicating the requested type of service is not available. There is no WSAPROTOCOL_INFO struct about a Service Provider available to an application if that Service Provider is not registered with WS2 32.DLL.

F.4.2 Tracing Problems in the API and the Service Provider

When developing your application, you must be able to isolate problems among:

- The client application under development
- The WinSock 2 DLL
- The FORE ATM Service Provider

You can trace problems with the WinSock 2 debug/trace layer. It can be used to monitor, and to some extent control, all procedure calls across the WinSock 2 API or the Service Provider. This layer is a DLL supported by a special version of the WinSock 2 DLL. The debug/trace DLL (DT_DLL.DLL) and the special WinSock 2 DLL for use with debug/trace are included with the WinSock 2 SDK.

Please contact FORE Systems technical support for issues relating to the FORE ATM Service Provider only. Contacting FORE technical support is described in "Technical Support" on page iii.

F.4.3 Sample Programs

The FORE service provide files include sample Winsock2 programs in the \SAMPLE directory. These files are not copied by the installation program.

F.5 Brief Overview of ATM

This section is a brief overview of some ATM concepts. Please refer to the many web sites and reference books available for a more thorough explanation of ATM networking.

Asynchronous Transfer Mode, or ATM, is a connection-based communication architecture based on the switching of small fixed length packets of data called *cells*. In ATM, all data is transferred in 53-byte cells. Each cell has a 5-byte header that identifies the cell's route through the network and 48-bytes containing user data. This user data in turn, carries any headers or trailers required by higher level protocols.

F.5.1 Virtual Channels and Virtual Paths

The set of mappings in the ATM network used to route cells from a source to a destination are generally referred to as virtual channels and virtual paths. Signalling can be used to create the virtual channels and virtual paths needed to establish a connection between two ATM endpoints. Virtual paths are used to establish connections among switches in an ATM network. Once the switch fabrics are connected via a virtual path, they can use this virtual path to route virtual channels.

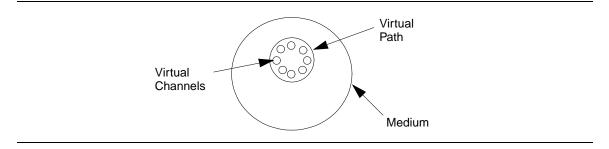


Figure F.2 - Virtual Channels and Paths

Each ATM cell contains a virtual path identifier (VPI) and a virtual channel identifier (VCI) as part of its five-byte ATM header. The VPI and VCI are used to route the cell through the ATM network.

Virtual channels "ride" inside of virtual paths. The combination of the two specifies a virtual connection. On a switch fabric, each virtual channel switches cells with a specific VPI and VCI received on a specific port to another port with a new VPI and a new VCI. Unlike through paths, virtual channels describe a single virtual connection between two endpoints connected to a switch fabric.

F.5.1.1 Switched and Permanent Virtual Channels

There are generally two types of virtual channels:

- Switched Virtual Channels (SVCs), which are established by network signalling, and last only for the duration of the information transfer.
- Permanent Virtual Channels (PVCs), which are established manually for dedicated long-term information transport between locations. PVCs may be required when signalling cannot be used. PVCs can be created from the WinSock API using WSAIoctl(SIO_ASSOCIATE_PVC)

The virtual channels are identified by the VPI and VCI.



In this release of the FORE Service Provider, only VPI 0 (zero) is available.

F.5.1.2 ATM Addresses

The ATM address is 20 bytes in length and is specified as 40 hexadecimal characters. Three address formats have been specified: DCC, ICD, and E.164. FORE Systems implements the ICD ATM format. Per the UNI specifications, all private networks should accept initial call setup messages containing ATM address with any of the approved formats and forward the calls as necessary.

The logical components of an ATM address are:

• The *NSAP* or *switch prefix*, consisting of the first 13 bytes, which is typically the same for all ports on a single switch. For example:

47000580ffe1000000f2150f5b

• The *end system identifier (ESI)*, consisting of bytes 14 through 19, which usually is the six-byte hardware MAC address of a particular adapter card. For example:

002048102aef

• The *selector byte*, the last byte of the ATM address, serves the same purpose as a TCP port, which is to identify a service access point. For example:

0a

The following is a sample of the entire ATM address:

47000580ffe1000000f2150f5b002048102aef0a

Using the FORE ATM Service Provider with WinSock 2

Glossary

802.1d Spanning Tree Bridging - the IEEE standard for bridging; a MAC layer standard for transparently connecting two or more LANs (often called subnetworks) that are running the same protocols and cabling. This arrangement creates an extended network, in which any two workstations on the linked LANs can share data.

802.3 Ethernet - the IEEE standard for Ethernet; a physical-layer standard that uses the CSMA/CD access method on a bus-topology LAN.

802.5 Token Ring - the IEEE physical-layer standard that uses the token-passing access method on a ring-topology LAN.

AAL (ATM Adaptation Layer) - the AAL divides the user information into segments suitable for packaging into a series of ATM cells. There are several types of AALs in use. FORE Systems currently supports AAL 5 and AAL 3/4. AAL 3/4 supports connection-oriented VBR data transfer and connectionless VBR data transfer, respectively. AAL 5 is defined as Simple and Efficient Adaptation Layer (SEAL).

AAL Connection - an association established by the AAL between two or more next higher layer entities.

ABR (Available Bit Rate) - a type of traffic for which the ATM network attempts to meet that traffic's bandwidth requirements. It does not guarantee a specific amount of bandwidth and the end station must retransmit any information that did not reach the far end.

ACR (Allowable Cell Rate) - parameter defined by the ATM Forum for ATM traffic management. ACR varies between the MCR and the PCR, and is dynamically controlled using congestion control mechanisms.

Address Mask - a bit mask used to identify which bits in an address (usually an IP address) are network significant, subnet significant, and host significant portions of the complete address. This mask is also known as the subnet mask because the subnetwork portion of the address can be determined by comparing the binary version of the mask to an IP address in that subnet. The mask holds the same number of bits as the protocol address it references.

Agent (SNMP) - a component of network- and desktop-management software, such as SNMP, that gathers information from MIBs.

AIS (Alarm Indication Signal) - a line AIS is asserted when a 111 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. A line AIS is removed when any pattern other than 111 is detected in these bits for five consecutive frames.

alarm - an unsolicited message from a device, typically indicating a problem with the system that requires attention.

AMI (ATM Management Interface) - the user interface to FORE Systems' *ForeThought* switch control software (SCS). AMI lets users monitor and change various operating configurations of FORE Systems switches and network module hardware and software, IP connectivity, and SNMP network management.

ANSI (American National Standards Institute) - a private organization that coordinates the setting and approval of some U.S. standards. It also represents the United States to the International Standards Organization.

API (Application Program Interface) - a language format that defines how a program can be made to interact with another program, service, or other software; it allows users to develop custom interfaces with FORE products.

APP (application program) - a complete, self-contained program that performs a specific function directly for the user.

AppleTalk - a networking protocol developed by Apple Computer for communication between Apple's products and other computers. Independent of the network layer, AppleTalk runs on LocalTalk, EtherTalk and TokenTalk.

ARP (Address Resolution Protocol) - a method used to resolve higher level protocol addressing (such as IP) into the appropriate header data required for ATM; i.e., port, VPI, and VCI; also defines the AAL type to be used.

ASCII (American Standard Code for Information Interchange) - a standard character set that (typically) assigns a 7-bit sequence to each letter, number, and selected control characters.

Assigned Cell - a cell that provides a service to an upper layer entity or ATM Layer Management entity (ATMM-entity).

asxmon - a FORE program that repeatedly displays the state of the switch and of all its active ports.

ATDM (Asynchronous Time Division Multiplexing) - a method of sending information that resembles normal TDM, except that time slots are allocated as needed rather than preassigned to specific transmitters.

ATM (Asynchronous Transfer Mode) - a transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.

ATM Forum - an international non-profit organization formed with the objective of accelerating the use of ATM products and services through a rapid convergence of interoperability specifications. In addition, the Forum promotes industry cooperation and awareness.

ATM Layer link - a section of an ATM Layer connection between two adjacent active ATM Layer entities (ATM-entities).

ATM Link - a virtual path link (VPL) or a virtual channel link (VCL).

ATM Peer-to-Peer Connection - a virtual channel connection (VCC) or a virtual path connection (VPC) directly established, such as workstation-to-workstation. This setup is not commonly used in networks.

ATM Traffic Descriptor - a generic list of parameters that can be used to capture the intrinsic traffic characteristics of a requested ATM connection.

ATM User-to-User Connection - an association established by the ATM Layer to support communication between two or more ATM service users (i.e., between two or more next higher layer entities or between two or more ATM entities). The communication over an ATM Layer connection may be either bidirectional or unidirectional. The same Virtual Channel Identifier (VCI) is used for both directions of a connection at an interface.

atmarp - a FORE program that shows and manipulates ATM ARP entries maintained by the given device driver. This is also used to establish PVC connections.

atmconfig - a FORE program used to enable or disable SPANS signalling.

atmstat - a FORE program that shows statistics gathered about a given adapter card by the device driver. These statistics include ATM layer and ATM adaptation layer cell and error counts. This can also be used to query other hosts via SNMP.

AUI (Attachment User Interface) - IEEE 802.3 interface between a media attachment unit (MAU) and a network interface card (NIC). The term AUI can also refer to the rear panel port to which an AUI cable might attach.

Auto-logout - a feature that automatically logs out a user if there has been no user interface activity for a specified length of time.

B8ZS (Bipolar 8 Zero Substitution) - a line coding technique used to accommodate the ones density requirements of T1 facilities.

Backbone - the main connectivity device of a distributed system. All systems that have connectivity to the backbone connect to each other. This does not stop systems from setting up private arrangements with each other to bypass the backbone for cost, performance, or security.

Bandwidth - usually identifies the capacity or amount of data that can be sent through a given circuit; may be user-specified in a PVC.

baud - unit of signalling speed. The speed in baud is the number of discrete conditions or signal events per second. If each signal event represents only one bit, the baud rate is the same as bps; if each signal event represents more than one bit (such as a dibit), the baud rate is smaller than bps.

BECN (Backward Explicit Congestion Notification) - bit set by a Frame Relay network in frames traveling in the opposite direction of frames encountering a congested path. Data terminal equipment (DTE) receiving frames with the BECN bit set can request that higher-level protocols take flow control action as appropriate. Compare with *FECN*.

BES (Bursty Errored Seconds) - a BES contains more than 1 and fewer than 320 path coding violation error events, and no severely errored frame or AIS defects. Controlled slips are not included in determining BESs.

BGP (Border Gateway Protocol) - used by gateways in an internet connecting autonomous networks. It is derived from experiences learned using the EGP.

BIP (Bit Interleaved Parity) - an error-detection technique in which character bit patterns are forced into parity, so that the total number of one bits is always odd or always even. This is accomplished by the addition of a one or zero bit to each byte, as the byte is transmitted; at the other end of the transmission, the receiving device verifies the parity (odd or even) and the accuracy of the transmission.

B-ISDN (Broadband Integrated Services Digital Network) - a common digital network suitable for voice, video, and high-speed data services running at rates beginning at 155 Mbps.

BNC (Bayonet-Neill-Concelman) - a bayonet-locking connector for miniature coax.

BPDU (Bridged Protocol Data Unit) - Spanning-tree Protocol hello packet that is sent out at configurable intervals to exchange information among bridges in the network.

bps (bits per second) - a measure of speed or data rate. Often combined with metric prefixes in kbps for thousands of bits per second (k fir kilo-) and in Mbps for millions of bits per second (M for mega-).

BPV (Bipolar Violation) - an error event on a line in which the normal pattern of alternating high (one) and low (zero) signals is disrupted. A bipolar violation is noted when two high signals occur without an intervening low signal, or vice versa.

Bridge - a device that expands a Local Area Network by forwarding frames between data link layers associated with two separate cables, usually carrying a common protocol. Bridges can usually be made to filter certain packets (to forward only certain traffic).

Broadband - a service or system requiring transmission channels capable of supporting rates greater than the Integrated Services Digital Network (ISDN) primary rate.

Broadband Access - an ISDN access capable of supporting one or more broadband services.

Brouter (bridging/router) - a device that routes some protocols and bridges others based on configuration information.

Bursty Second - a second during which there were at least the set number of BES threshold event errors but fewer than the set number of SES threshold event errors.

BUS (Broadcast and Unknown Server) - in an emulated LAN, the BUS is responsible for accepting broadcast, multicast, and unknown unicast packets from the LECs to the broadcast MAC address (FFFFFFFFFFFF) via dedicated point-to-point connections, and forwarding the packets to all of the members of the ELAN using a single point-to-multipoint connection.

CAC (Connection Admission Control) - the procedure used to decide if a request for an ATM connection can be accepted based on the attributes of both the requested connection and the existing connections.

Call - an association between two or more users or between a user and a network entity that is established by the use of network capabilities. This association may have zero or more connections.

Carrier - a company, such as any of the "baby Bell" companies, that provide network communications services, either within a local area or between local areas.

CBR (Constant Bit Rate) - a type of traffic that requires a continuous, specific amount of bandwidth over the ATM network (e.g., digital information such as video and digitized voice).

CBR port - a port on the *CellPath* 300 for transmitting and receiving CBR traffic.

cchan - a FORE program used to manage virtual channels on a FORE Systems ATM switch running asxd.

CCITT (Consultative Committee for International Telephone and Telegraph) - an international consultative committee that sets international communications recommendations, which are frequently adopted as standards; develops interface, modem, and data network recommendations. Membership includes PTTs, scientific and trade associations, and private companies. CCITT is part of the International Communications Union (a United nations treaty organization in Geneva).

CDV (**Cell Delay Variation**) - a quantification of cell clumping for a connection. The cell clumping CDV (yk) is defined as the difference between a cell's expected reference arrival time (ck) and its actual arrival time (ak). The expected reference arrival time (ck) of cell k of a specific connection is max $[c_{\{k-1\}} + T, a_k]$. T is the reciprocal of the negotiated peak cell rate.

CE (Connection Endpoint) - a terminator at one end of a layer connection within a SAP.

CEI (Connection Endpoint Identifier) - an identifier of a CE that can be used to identify the connection at a SAP.

Cell - an ATM Layer protocol data unit (PDU). The basic unit of information transported in ATM technology, each 53-byte cell contains a 5-byte header and a 48-byte payload.

Cell Delineation - the protocol for recognizing the beginning and end of ATM cells within the raw serial bit stream.

Cell Header - ATM Layer protocol control information.

Cell Port - a port on the *CellPath* 300 that transmits and receives traffic in cell format.

Cell Rate Adaptation - a function performed by a protocol module in which empty cells (known as unassigned cells) are added to the output stream. This is because there always must be a fixed number of cells in the output direction; when there are not enough cells to transmit, unassigned cells are added to the output data stream.

Cell Transfer Delay - the transit delay of an ATM cell successfully passed between two designated boundaries.

CES (Circuit emulation Services) - The *CellPath* 90 supports Circuit Emulation Services (CES) for applications requiring a fixed delay, lossless end-to-end connection through the network. In essence, CES provides a virtual private line service to the connecting application.

Channelization - capability of transmitting independent signals together over a cable while still maintaining their separate identity for later separation.

CLP (Cell Loss Priority) - the last bit of byte four in an ATM cell header; indicates the eligibility of the cell for discard by the network under congested conditions. If the bit is set to 1, the cell may be discarded by the network depending on traffic conditions.

Cold Start Trap - a *CellPath* 300 SNMP trap which is sent when the unit has been power-cycled (*see* trap).

Comm Port - the front panel DCE port that allows access to the *CellPath* 300 user interface via a connected terminal.

Concentrator - a communications device that offers the ability to concentrate many lower-speed channels into and out of one or more high-speed channels.

Congestion Management - a *CellPath* 300 feature that helps ensure reasonable service for VBR connections in an ATM network. For each connection, the *CellPath* 300 maintains a priority, sustained cell rate (SCR), and peak cell rate (PCR). During times of congestion, the *CellPath* 300 reduces the bandwidth to the SCR, based on the priority of the connection.

Connection - the concatenation of ATM Layer links in order to provide an end-to-end information transfer capability to access points.

Connectionless Service - a type of service in which no pre-determined path or link has been established for transfer of information, supported by AAL 4.

Connection-Oriented Service - a type of service in which information always traverses the same pre-established path or link between two points, supported by AAL 3.

Controlled Slip - a situation in which one frame's worth of data is either lost or replicated. A controlled slip typically occurs when the sending device and receiving device are not using the same clock.

Corresponding Entities - peer entities with a lower layer connection among them.

cpath - a FORE program used to manage virtual paths on a FORE Systems ATM switch running asxd.

CPE (Customer Premise Equipment) - equipment that is on the customer side of the point of demarcation, as opposed to equipment that is on a carrier side. *See also* point of demarcation.

cport - a FORE program used to monitor and change the state of ports on a FORE Systems ATM switch running asxd.

CRC (Cyclic Redundancy Check) - an error detection scheme in which a number is derived from the data that will be transmitted. By recalculating the CRC at the remote end and comparing it to the value originally transmitted, the receiving node can detect errors.

Cross Connection - a mapping between two channels or paths at a network device such as the *CellPath* 300.

CD (Controlled Slip) - a situation in which one frame's worth of data is either lost or replicated. A controlled slip typically occurs when the sending device and receiving device are not using the same clock.

CS (Convergence Sublayer) - a portion of the AAL. Data is passed first to the CS where it is divided into rational, fixed-length packets or PDUs (Protocol Data Units). For example, AAL 4 processes user data into blocks that are a maximum of 64 kbytes long.

CTS (Clear To Send) - and RS-232 modem interface control signal (sent from the modem to the DTE on pin 5) which indicates that the attached DTE may begin transmitting; issuance in response to the DTE's RTS.

D4 framing - See SF)

DARPA (Defense Advanced Research Projects Agency) - the US government agency that funded the ARPANET.

Datagram - a packet of information used in a connectionless network service that is routed to its destination using an address included in the datagram's header.

DCE (Data Communications Equipment) - a definition in the RS232C standard that describes the functions of the signals and the physical characteristics of an interface for a communication device such as a modem.

DCS (Digital Cross-connect System) - an electronic patch panel used to route digital signals in a central office.

Demultiplexing - a function performed by a layer entity that identifies and separates SDUs from a single connection to more than one connection (*see* multiplexing).

DFA (DXI Frame Address) - a connection identifier associated with ATM DXI packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

DIP Switch (Dual In-line Package) - a device that has two parallel rows of contacts that let the user switch electrical current through a pair of those contacts to on or off. They are used to reconfigure components and peripherals.

DLCI (Data Link Connection Identifier) - a connection identifier associated with frame relay packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

Domain Name Server - a computer that converts names to their corresponding Internet numbers. It allows users to telnet or FTP to the name instead of the number.

DNS (Domain Name System) - the distributed name and address mechanism used in the Internet.

DSn (Digital Standard n (0, 1, 1C, 2, and 3)) - a method defining the rate and format of digital hierarchy, with asynchronous data rates defined as follows:

DS0	64kbps	1 voice channel
DS1	1.544Mbps	24 DS0s
DS1C	3.152 Mbps	2 DS1s
DS2	6.312 Mbps	4 DS1s
DS3	44.736 Mbps	28 DS1s

Synchronous data rates (SONET) are defined as:

STS-1/OC-1	51.84 Mbps	28 DS1s or 1 DS3
STS-3/OC-3	155.52 Mbps	3 STS-1s byte interleaved
STS-3c/OC-3c	155.52 Mbps	Concatenated, indivisible payload
STS-12/OC-12	622.08 Mbps	12 STS-1s, 4 STS-3cs, or any mixture
STS-12c/OC-12c	622.08 Mbps	Concatenated, indivisible payload
STS-48/OC-48	2488.32 Mbps	48 STS-1s, 16 STS-3cs, or any mixture

DSR (Data Set Ready) - an RS-232 modem interface control signal (sent from the modem to the DTE on pin 6) which indicates that the modem is connected to the telephone circuit. Usually a prerequisite to the DTE issuing RTS.

DTE (Data Terminal Equipment) - generally user devices, such as terminals and computers, that connect to data circuit-terminating equipment. They either generate or receive the data carried by the network.

DTR (Data Terminal Ready) - an RS232 modem interface control signal (sent from the DTE to the modem on pin 20) which indicates that the DTE is ready for data transmission and which requests that the modem be connected to the telephone circuit.

DXI - a generic phrase used in the full names of several protocols, all commonly used to allow a pair of DCE and DTE devices to share the implementation of a particular WAN protocol. The protocols all define the packet formats used to transport data packets between DCE and DTE devices.

E1 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 2.048 Mbps. E1 lines can be leased for private use from common carriers.

E3 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 34.368 Mbps. E3 lines can be leased for private use from common carriers.

EEPROM (Electrically Erasable Programmable Read Only Memory) - an EPROM that can be cleared with electrical signals rather than the traditional ultraviolet light.

EFCI (Explicit Forward Congestion Indication) - the second bit of the payload type field in the header of an ATM cell, the EFCI bit indicates network congestion to receiving hosts. On a congested switch, the EFCI bit is set to "1" by the transmitting network module when a certain number of cells have accumulated in the network module's shared memory buffer. When a cell is received that has its EFCI bit set to "1," the receiving host notifies the sending host, which should then reduce its transmission rate.

EGP (Exterior Gateway) Protocol - used by gateways in an internet, connecting autonomous networks.

EIA (Electronics Industries Association) - a USA trade organization that issues its own standards and contributes to ANSI; developed RS-232. Membership includes USA manufacturers.

EISA (Extended Industry Standard Architecture) - a bus architecture for desktop computers that provides a 32-bit data passage while maintaining compatibility with the ISA or AT architecture.

elarp - a FORE program that shows and manipulates MAC and ATM address mappings for LAN Emulation Clients (LECs).

elconfig - a FORE program that shows and modifies LEC configuration. Allows the user to set the NSAP address of the LAN Emulation Configuration Server (LECS), display the list of Emulated LANs (ELANs) configured in the LECS for this host, display the list of ELANs locally configured along with the membership state of each, and locally administer ELAN membership.

EM - the *CellPath* 300 extension module; paired with the system controller and supporting an optional PCMCIA card.

Embedded SNMP Agent - an SNMP agent can come in two forms: embedded or proxy. An embedded SNMP agent is integrated into the physical hardware and software of the unit. The *CellPath* 300 has an internal, integrated SNMP agent.

EMI (Electromagnetic Interference) - signals generated and radiated by an electronic device that cause interference with radio communications, among other effects.

End-to-End Connection - when used in reference to an ATM network, a connection that travels through an ATM network, passing through various ATM devices and with endpoints at the termination of the ATM network.

EPROM - Erasable Programmable Read Only Memory (see PROM).

EQL (Equalization) - the process of compensating for line distortions.

ES (End System) - a system in which an ATM connection is terminated or initiated. An originating end system initiates the ATM connection, and a terminating end system terminates the ATM connection. OAM cells may be generated and received.

ES (Errored Seconds) - a second during which at least one code violation occurred.

ESF (Extended Superframe) - T1 framing standard that provides frame synchronization, cyclic redundancy, and data link bits.

Ethernet - a 10-Mbps, coaxial standard for LANs in which all nodes connect to the cable where they contend for access.

Fairness - as related to Generic Flow Control (GFC), fairness is defined as meeting all of the agreed quality of service (QoS) requirements by controlling the order of service for all active connections.

Far-End - in a relationship between two devices in a circuit, the far-end device is the one that is remote.

FCC - a board of commissioners appointed by the President under the Communications Act of 1934, with the authority to regulate all interstate telecommunications originating in the United States, including transmission over phone lines.

FDDI (Fiber Distributed Data Interface) - high-speed data network that uses fiber-optic as the physical medium. Operates in similar manner to Ethernet or Token Ring, only faster.

FDM (Frequency Division Multiplexing) - a method of dividing an available frequency range into parts with each having enough bandwidth to carry one channel.

FEBE (Far End Block Error) - an error detected by extracting the 4-bit FEBE field from the path status byte (G1). The legal range for the 4-bit field is between 0000 and 1000, representing zero to eight errors. Any other value is interpreted as zero errors.

FECN (Forward Explicit Congestion Notification) - bit set by a Frame Relay network to inform data terminal equipment (DTE) receiving the frame that congestion was experienced in the path from source to destination. DTE receiving frames with the FECN bit set can request that higher-level protocols take flow control action as appropriate. Compare with *BECN*.

FERF (Far End Receive Failure) - a line error asserted when a 110 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. A line FERF is removed when any pattern other than 110 is detected in these bits for five consecutive frames.

FIFO (First-In, First-Out) - a method of coordinating the sequential flow of data through a buffer.

Flag - a specific bit pattern used to identify the beginning or end of a frame.

Frame - a variable length group of data bits with a specific format containing flags at the beginning and end to provide demarcation.

Frame Relay - a fast packet switching protocol based on the LAPD protocol of ISDN that performs routing and transfer with less overhead processing than X.25.

Frame Synchronization Error - an error in which one or more time slot framing bits are in error.

Framing - a protocol that separates incoming bits into identifiable groups so that the receiving multiplexer recognizes the grouping.

FT-PNNI (ForeThought PNNI) - a FORE Systems routing and signalling protocol that uses private ATM (NSAP) addresses; a precursor to ATM Forum PNNI (*see* PNNI).

FTP (File Transfer Protocol) - a TCP/IP protocol that lets a user on one computer access, and transfer data to and from, another computer over a network. ftp is usually the name of the program the user invokes to accomplish this task.

GCRA (Generic Cell Rate Algorithm) - an algorithm which is employed in traffic policing and is part of the user/network service contract. The GCRA is a scheduling algorithm which ensures that cells are marked as *conforming* when they arrive when expected or later than expected and *non-conforming* when they arrive sooner than expected.

GFC (Generic Flow Control) - the first four bits of the first byte in an ATM cell header. Used to control the flow of traffic across the User-to-Network Interface (UNI), and thus into the network. Exact mechanisms for flow control are still under investigation and no explicit definition for this field exists at this time. (This field is used only at the UNI; for NNI-NNI use (between network nodes), these four bits provide additional network address capacity, and are appended to the VPI field.)

GIO - a proprietary bus architecture used in certain Silicon Graphics, Inc. workstations.

Header - protocol control information located at the beginning of a protocol data unit.

HDB3 (High Density Bipolar) - line-code type standard for T1 where each block of three zeros is replaced by 00V or B0V, where B represents an inserted pulse conforming to the AMI rule (ITU-T G.701, item 9004) and V represents an AMI violation (ITU-T G.701, item 9007). The choice of 00V or B0V is made so that the number of B pulses between consecutive V pulses is odd (successive V pulses are of alternate polarity so that no d.c. component is introduced). Compare with AMI.

HDLC (High-Level Data Link Control) - Bit-oriented synchronous data link layer protocol developed by the ISO. Derived from SDLC, HDLC specifies a data encapsulation method on synchronous serial links using frame characters and checksums. See also *SDLC*.

HEC (Header Error Control) - a CRC code located in the last byte of an ATM cell header that is used for checking cell integrity only.

HIPPI (High Performance Parallel Interface) - ANSI standard that extends the computer bus over fairly short distances at speeds of 800 and 1600 Mbps.

HPUX - the Hewlett-Packard version of UNIX.

HSSI (High-Speed Serial Interface) - a serial communications connection that operates at speeds of up to 1.544 Mbps.

Hub - a device that connects several other devices, usually in a star topology.

I/O Module - FORE's interface cards for the LAX-20 LAN Access Switch, designed to connect Ethernet, Token Ring, and FDDI LANs to *ForeRunner* ATM networks.

ICMP (Internet Control Message Protocol) - the protocol that handles errors and control messages at the IP layer. ICMP is actually a part of the IP protocol layer. It can generate error messages, test packets, and informational messages related to IP.

IEEE (Institute of Electrical and Electronics Engineers) - the world's largest technical professional society. Based in the U.S., the IEEE sponsors technical conferences, symposia & local meetings worldwide, publishes nearly 25% of the world's technical papers in electrical, electronics & computer engineering, provides educational programs for members, and promotes standardization.

IETF (Internet Engineering Task Force) - a large, open, international community of network designers, operators, vendors and researchers whose purpose is to coordinate the operation, management and evolution of the Internet to resolve short- and mid-range protocol and architectural issues.

ILMI (Interim Local Management Interface) - the standard that specifies the use of the Simple Network Management Protocol (SNMP) and an ATM management information base (MIB) to provide network status and configuration information.

Interface Data - the unit of information transferred to/from the upper layer in a single interaction across a SAP. Each Interface Data Unit (IDU) controls interface information and may also contain the whole or part of the SDU.

internet - while an internet is a network, the term "internet" is usually used to refer to a collection of networks interconnected with routers.

Internet - (note the capital "I") the largest internet in the world including large national backbone nets and many regional and local networks worldwide. The Internet uses the TCP/IP suite. Networks with only e-mail connectivity are not considered on the Internet.

Internet Addresses - the numbers used to identify hosts on an internet network. Internet host numbers are divided into two parts; the first is the network number and the second, or local, part is a host number on that particular network. There are also three classes of networks in the Internet, based on the number of hosts on a given network. Large networks are classified as Class A, having addresses in the range 1-126 and having a maximum of 16,387,064 hosts. Medium networks are classified as Class B, with addresses in the range 128-191 and with a maximum of 64,516 hosts. Small networks are classified as Class C, having addresses in the range 192-254 with a maximum of 254 hosts. Addresses are given as dotted decimal numbers in the following format:

nnn.nnn.nnn

In a Class A network, the first of the numbers is the network number, the last three numbers are the local host address.

In a Class B network, the first two numbers are the network, the last two are the local host address.

In a Class C network, the first three numbers are the network address, the last number is the local host address.

The following table summarizes the classes and sizes:

<u>Class</u>	First #	Max# Hosts
A	1-126	16,387,064
В	129-191	64,516
C	192-223	254

Network mask values are used to identify the network portion and the host portion of the address. For:

Class A - the default mask is 255.0.0.0

Class B - the default mask is 255.255.0.0

Class C - the default mask is 255.255.255.0

Subnet masking is used when a portion of the host ID is used to identify a subnetwork. For example, if a portion of a Class B network address is used for a subnetwork, the mask could be set as 255.255.255.0. This would allow the third byte to be used as a subnetwork address. All hosts on the network would still use the IP address to get on the Internet.

IP (Internet Protocol) - a connectionless, best-effort packet switching protocol that offers a common layer over dissimilar networks.

IP Address - a unique 32-bit integer used to identify a device in an IP network. You will most commonly see IP addresses written in "dot" notation; for instance, 192.228.32.14 (*see* IP netmask).

IP Netmask - a pattern of 32 bits that is combined with an IP address to determine which bits of an IP address denote the network number and which denote the host number. Netmasks are useful for sub-dividing IP networks. IP netmasks are written in "dot" notation; for instance, 255.255.255.0 (*see* IP address).

IPX Protocol (Internetwork Packet Exchange) - a NetWare protocol similar to the Xerox Network Systems (XNS) protocol that provides datagram delivery of messages.

IS (Intermediate system) - a system that provides forwarding functions or relaying functions or both for a specific ATM connection. OAM cells may be generated and received.

ISA Bus - a bus standard developed by IBM for expansion cards in the first IBM PC. The original bus supported a data path only 8 bits wide. IBM subsequently developed a 16-bit version for its AT class computers. The 16-bit AT ISA bus supports both 8- and 16-bit cards. The 8-bit bus is commonly called the PC/XT bus, and the 16-bit bus is called the AT bus.

ISDN (Integrated Services Digital Network) - an emerging technology that is beginning to be offered by the telephone carriers of the world. ISDN combines voice and digital network services into a single medium or wire.

ISO (International Standards Organization) - a voluntary, non treaty organization founded in 1946 that is responsible for creating international standards in many areas, including computers and communications.

Isochronous - signals carrying embedded timing information or signals that are dependent on uniform timing; usually associated with voice and/or video transmission.

ITU (International Telecommunications Union) - the telecommunications agency of the United Nations, established to provide standardized communications procedures and practices, including frequency allocation and radio regulations, on a worldwide basis.

 ${\bf J2}$ - Wide-area digital transmission scheme used predominantly in Japan that carries data at a rate of 6.312 Mbps.

Jitter - analog communication line distortion caused by variations of a signal from its reference timing position.

Jumper - a patch cable or wire used to establish a circuit, often temporarily, for testing or diagnostics; also, the devices, shorting blocks, used to connect adjacent exposed pins on a printed circuit board that control the functionality of the card.

LAN (Local Area Network) - a data network intended to serve an area of only a few square kilometers or less. Because the network is known to cover only a small area, optimizations can be made in the network signal protocols that permit higher data rates.

lane - a program that provides control over the execution of the LAN Emulation Server (LES), Broadcast/Unknown Server (BUS), and LAN Emulation Configuration Server (LECS) on the local host.

LAN Access Concentrator - a LAN access device that allows a shared transmission medium to accommodate more data sources than there are channels currently available within the transmission medium.

LAPB (Link Access Procedure, Balanced) - Data link protocol in the X.25 protocol stack. LAPB is a bit-oriented protocol derived from HDLC. See also HDLC and X.25.

LAX-20 - a FORE Systems LAN Access Switch, designed to connect Ethernet, Token Ring, and FDDI LANs to *ForeRunner* ATM networks. The LAX-20 is a multiport, multiprotocol internetworking switch that combines the advantages of a high-performance LAN switch and a full-featured ATM interface capable of carrying LAN traffic.

Layer Entity - an active layer within an element.

Layer Function - a part of the activity of the layer entities.

Layer Service - a capability of a layer and the layers beneath it that is provided to the upper layer entities at the boundary between that layer and the next higher layer.

Layer User Data - the information transferred between corresponding entities on behalf of the upper layer or layer management entities for which they are providing services.

le - a FORE program that implements both the LAN Emulation Server (LES) and the Broadcast/Unknown Server (BUS).

LEC (LAN Emulation Client) - the component in an end system that performs data forwarding, address resolution, and other control functions when communicating with other components within an ELAN.

lecs - a FORE program that implements the assignment of individual LECs to different emulated LANs.

LECS (LAN Emulation Configuration Server) - the LECS is responsible for the initial configuration of LECs. It provides information about available ELANs that a LEC may join, together with the addresses of the LES and BUS associated with each ELAN.

leq - a FORE program that provides information about an ELAN. This information is obtained from the LES, and includes MAC addresses registered on the ELAN together with their corresponding ATM addresses.

LES (LAN Emulation Server) - the LES implements the control coordination function for an ELAN. The LES provides the service of registering and resolving MAC addresses to ATM addresses.

Link Down Trap - a *CellPath* 300 SNMP trap that signifies that the Ethernet interface has transitioned from a normal state to an error state, or has been disconnected.

Link Up Trap - a *CellPath* 300 SNMP trap that signifies that the Ethernet interface has transitioned from an error condition to a normal state.

LLC (Logical Link Control) - a protocol developed by the IEEE 802 committee for data-link-layer transmission control; the upper sublayer of the IEEE Layer 2 (OSI) protocol that complements the MAC protocol; IEEE standard 802.2; includes end-system addressing and error checking.

LOF (Loss Of Frame) - a type of transmission error that may occur in wide-area carrier lines.

Loopback - a troubleshooting technique that returns a transmitted signal to its source so that the signal can be analyzed for errors. Typically, a loopback is set at various points in a line until the section of the line that is causing the problem is discovered.

looptest - a program that tests the interface for basic cell reception and transmission functionality. It is usually used for diagnostic purposes to determine if an interface is functioning properly.

LOP (Loss Of Pointer) - a type of transmission error that may occur in wide-area carrier lines.

LOS (Loss Of Signal) - a type of transmission error that may occur in wide-area carrier lines.

MAC (Media Access Control) - a media-specific access control protocol within IEEE 802 specifications; currently includes variations for Token Ring, token bus, and CSMA/CD; the lower sublayer of the IEEE's link layer (OSI), which complements the Logical Link Control (LLC).

MAU (Media Attachment Unit) - device used in Ethernet and IEEE 802.3 networks that provides the interface between the AUI port of a station and the common medium of the Ethernet. The MAU, which can be built into a station or can be a separate device, performs physical layer functions including conversion of the digital data from the Ethernet interface, collision detection, and injection of bits onto the network.

Maximum Burst Tolerance - the largest burst of data that a network device is guaranteed to handle without discarding cells or packets. Bursts of data larger than the maximum burst size may be subject to discard.

MCR (Minimum Cell Rate) - parameter defined by the ATM Forum for ATM traffic management. MCR is defined only for ABR transmissions, and specifies the minimum value for the ACR.

Metasignalling - an ATM Layer Management (LM) process that manages different types of signalling and possibly semipermanent virtual channels (VCs), including the assignment, removal, and checking of VCs.

Metasignalling VCs - the standardized VCs that convey metasignalling information across a User-to-Network Interface (UNI).

MIB (Management Information Base) - the set of parameters that an SNMP management station can query or set in the SNMP agent of a networked device (e.g., router).

MIC (Media Interface Connector) - the optical fiber connector that joins the fiber to the FDDI controller.

MicroChannel - a proprietary 16- or 32-bit bus developed by IBM for its PS/2 computers' internal expansion cards; also offered by others.

MTU (Maximum Transmission Unit) - the largest unit of data that can be sent over a type of physical medium.

Multi-homed - a device that has both an ATM and another network connection, typically Ethernet.

Multiplexing - a function within a layer that interleaves the information from multiple connections into one connection (*see* demultiplexing).

Multipoint Access - user access in which more than one terminal equipment (TE) is supported by a single network termination.

Multipoint-to-Point Connection - a Point-to-Multipoint Connection may have zero bandwidth from the Root Node to the Leaf Nodes, and non-zero return bandwidth from the Leaf Nodes to the Root Node. Such a connection is also known as a Multipoint-to-Point Connection.

Multipoint-to-Multipoint Connection - a collection of associated ATM VC or VP links, and their associated endpoint nodes, with the following properties:

- 1. All N nodes in the connection, called Endpoints, serve as a Root Node in a Point-to-Multipoint connection to all of the (N-1) remaining endpoints.
- 2. Each of the endpoints can send information directly to any other endpoint, but the receiving endpoint cannot distinguish which of the endpoints is sending information without additional (e.g., higher layer) information.

Near-End - in a relationship between two devices in a circuit, the near-end device is the one that is local.

Network Module - ATM port interface cards which may be individually added or removed from any *ForeRunner* ATM switch to provide a diverse choice of connection alternatives. Each network module provides between one and six full-duplex ATM physical connections to the *ForeRunner* switch.

NMS (Network Management Station) - the system responsible for managing a network or a portion of a network. The NMS talks to network management agents, which reside in the managed nodes.

NNI (Network-to-Network Interface or Network Node Interface) - the interface between two public network pieces of equipment.

nonvolatile - a term used to describe a data storage device (memory) that retains its contents when power is lost.

NuBus - a high-speed bus used in the Macintosh family of computers, structured so that users can put a card into any slot on the board without creating conflict over the priority between those cards

OAM (Operation and Maintenance) Cell - a cell that contains ATM LM information. It does not form part of the upper layer information transfer.

octet - a grouping of 8 bits; similar, but not identical, to a byte.

OID (Object Identifier) - the address of a MIB variable.

OOF (Out-of-Frame) - a signal condition and alarm in which some or all framing bits are lost.

OpenView - Hewlett-Packard's network management software.

OSI (Open Systems Interconnection) - the 7-layer suite of protocols designed by ISO committees to be the international standard computer network architecture.

OSPF (Open Shortest Path First) Protocol - a routing algorithm for IP that incorporates least-cost, equal-cost, and load balancing.

Out-of-Band Management - refers to switch configuration via the serial port or over Ethernet. not ATM.

packet - a group of bits - including information bits and overhead bits - transmitted as a complete package on a network. Usually smaller than a transmission block.

Packet Port - a port on the *CellPath* 300 that transmits and receives packet traffic.

Packet Switching - a communications paradigm in which packets (messages) are individually routed between hosts with no previously established communications path.

Payload Scrambling - a technique that eliminates certain bit patterns that may occur within an ATM cell payload that could be misinterpreted by certain sensitive transmission equipment as an alarm condition.

PBX (Private Branch Exchange) - a private phone system (switch) that connects to the public telephone network and offers in-house connectivity. To reach an outside line, the user must dial a digit like 8 or 9.

PCI (Peripheral Component Interconnect) - a local-bus standard created by Intel.

PCM (Pulse Code Modulation) - a modulation scheme that samples the information signals and transmits a series of coded pulses to represent the data.

PCR (Peak Cell Rate) - parameter defined by the ATM Forum for ATM traffic management. In CBR transmissions, PCR determines how often data samples are sent. In ABR transmissions, PCR determines the maximum value of the ACR.

PDN (Public Data Network) - a network designed primarily for data transmission and intended for sharing by many users from many organizations.

PDU (Protocol Data Unit) - a unit of data specified in a layer protocol and consisting of protocol control information and layer user data.

Peak Cell Rate - at the PHY Layer SAP of a point-to-point VCC, the Peak Cell Rate Rpis the inverse of the minimum inter-arrival time T0 of the request to send an ATM-SDU.

Peer Entities - entities within the same layer.

PHY (Physical Layer) - the actual cards, wires, and/or fiber-optic cabling used to connect computers, routers, and switches.

Physical Layer (PHY) Connection - an association established by the PHY between two or more ATM-entities. A PHY connection consists of the concatenation of PHY links in order to provide an end-to-end transfer capability to PHY SAPs.

PLCP (Physical Layer Convergence Protocol) - a framing protocol that runs on top of the T1 or E1 framing protocol.

PLM (Physical Layer Module) - interface card in the *CellPath* 300 that provides the logic to support the physical layer of the network link. A PLM has the actual physical port mounted on it. Various PLMs support various physical layers, such as OC-3c/STM1 or DS3.

PLP (Packet Level Protocol) - Network layer protocol in the X.25 protocol stack. Sometimes called X.25 Level 3 or X.25 Protocol. See also X.25.

PM (**Protocol Module**) - interface card in the *CellPath* 300 that provides the logic supporting the protocol layer of the network link. Various PMs support various protocols, such as ATM cell, Frame Relay, or CBR traffic.

PMD (Physical Medium Dependent) - a sublayer concerned with the bit transfer between two network nodes. It deals with wave shapes, timing recovery, line coding, and electro-optic conversions for fiber based links.

PNNI (Private Network Node Interface or Private Network-to-Network Interface) - a protocol that defines the interaction of private ATM switches or groups of private ATM switches

ping (Packet Internet Groper) - a program used to test reachability of destinations by sending them an ICMP echo request and waiting for a reply.

Point-to-Multipoint Connection - a collection of associated ATM VC or VP links, with associated endpoint nodes, with the following properties:

- 1. One ATM link, called the Root Link, serves as the root in a simple tree topology. When the Root node sends information, all of the remaining nodes on the connection, called Leaf nodes, receive copies of the information.
- 2. Each of the Leaf Nodes on the connection can send information directly to the Root Node. The Root Node cannot distinguish which Leaf is sending information without additional (higher layer) information. (See the following note for Phase 1.)
- 3. The Leaf Nodes cannot communicate directly to each other with this connection type.

Note: Phase 1 signalling does not support traffic sent from a Leaf to the Root.

Point-to-Point Connection - a connection with only two endpoints.

Point of Demarcation - the dividing line between a carrier and the customer premise that is governed by strict standards that define the characteristics of the equipment on each side of the demarcation. Equipment on one side of the point of demarcation is the responsibility of the customer. Equipment on the other side of the point of demarcation is the responsibility of the carrier.

Policing - the function that ensures that a network device does not accept traffic that exceeds the configured bandwidth of a connection.

Primitive - an abstract, implementation-independent interaction between a layer service user and a layer service provider.

Priority - the parameter of ATM connections that determines the order in which they are reduced from the peak cell rate to the sustained cell rate in times of congestion. Connections with lower priority (4 is low, 1 is high) are reduced first.

PROM (Programmable Read-Only Memory) - a chip-based information storage area that can be recorded by an operator but erased only through a physical process.

Protocol - a set of rules and formats (semantic and syntactic) that determines the communication behavior of layer entities in the performance of the layer functions.

Protocol Control Information - the information exchanged between corresponding entities using a lower layer connection to coordinate their joint operation.

Proxy - the process in which one system acts for another system to answer protocol requests.

Proxy Agent - an agent that queries on behalf of the manager, used to monitor objects that are not directly manageable.

PSN (Packet Switched Network) - a network designed to carry data in the form of packets. The packet and its format is internal to that network.

PT (Payload Type) - bits 2...4 in the fourth byte of an ATM cell header. The PT indicates the type of information carried by the cell. At this time, values 0...3 are used to identify various types of user data, values 4 and 5 indicate management information, and values 6 and 7 are reserved for future use.

PVC (Permanent Virtual Circuit (or Channel)) - a circuit or channel through an ATM network provisioned by a carrier between two endpoints; used for dedicated long-term information transport between locations.

Q.2931 - Derived from Q.93B, the narrowband ISDN signalling protocol, an ITU standard describing the signalling protocol to be used by switched virtual circuits on ATM LANs.

Real-Time Clock - a clock that maintains the time of day, in contrast to a clock that is used to time the electrical pulses on a circuit.

Relaying - a function of a layer by means of which a layer entity receives data from a corresponding entity and transmits it to another corresponding entity.

RFCs (Requests For Comment) - IETF documents suggesting protocols and policies of the Internet, inviting comments as to the quality and validity of those policies. These comments are collected and analyzed by the IETF in order to finalize Internet standards.

RFI (Radio Frequency Interference) - the unintentional transmission of radio signals. Computer equipment and wiring can both generate and receive RFI.

RIP (Routing Information Protocol) - a distance vector-based protocol that provides a measure of distance, or hops, from a transmitting workstation to a receiving workstation.

RISC (Reduced Instruction Set Computer) - a generic name for CPUs that use a simpler instruction set than more traditional designs.

Router - a device that forwards traffic between networks or subnetworks based on network layer information.

RTS (Request To Send) - an RS-232 modem interface signal (sent from the DTE to the modem on pin 4) which indicates that the DTE has data to transmit.

SBus - hardware interface for add-in boards in later-version Sun 3 workstations.

SAP (Service Access Point) - the point at which an entity of a layer provides services to its LM entity or to an entity of the next higher layer.

SAR (Segmentation And Reassembly) - the SAR accepts PDUs from the CS and divides them into very small segments (44 bytes long). If the CS-PDU is less than 44 bytes, it is padded to 44 with zeroes. A two-byte header and trailer are added to this basic segment. The header identifies the message type (beginning, end, continuation, or single) and contains sequence numbering and message identification. The trailer gives the SAR-PDU payload length, exclusive of pad, and contains a CRC check to ensure the SAR-PDU integrity. The result is a 48-byte PDU that fits into the payload field of an ATM cell.

SC - *CellPath* 300 System Controller; paired with the Extension Module (EM).

SCR (sustainable cell rate) - parameter defined by the ATM Forum for ATM traffic management. For VBR connections, SCR determines the long-term average cell rate that can be transmitted.

SCSI (Small Computer Systems Interface) - a standard for a controller bus that connects disk drives and other devices to their controllers on a computer bus. It is typically used in small systems.

SDLC (Synchronous Data Link Control) - IBM's data link protocol used in SNA networks.

SDU (Service Data Unit) - a unit of interface information whose identity is preserved from one end of a layer connection to the other.

SEAL (Simple and Efficient Adaptation Layer) - also called AAL 5, this ATM adaptation layer assumes that higher layer processes will provide error recovery, thereby simplifying the SAR portion of the adaptation layer. Using this AAL type packs all 48 bytes of an ATM cell information field with data. It also assumes that only one message is crossing the UNI at a time. That is, multiple end-users at one location cannot interleave messages on the same VC, but must queue them for sequential transmission.

Segment - a single ATM link or group of interconnected ATM links of an ATM connection.

Semipermanent Connection - a connection established via a service order or via network management.

SES (Severely Errored Seconds) - a second during which more event errors have occurred than the SES threshold.

SF (Superframe) - Common framing type used on T1 circuits. SF consists of 12 frames of 192 bits each, with the 193rd bit providing error checking and other functions. SF has been superseded by ESF, but is still widely used. Also called *D4 framing*. See also ESF.

SGMP (Simple Gateway Management Protocol) - the predecessor to SNMP.

Shaping Descriptor - *n* ordered pairs of GCRA parameters (I,L) used to define the negotiated traffic shape of an APP connection. The traffic shape refers to the load-balancing of a network. In this context, load-balancing means configuring the data flows to maximize the efficiency of the network.

SIR (Sustained Information Rate) - the long-term average data transmission rate across the User-to-Network Interface.

SMDS (Switched Multimegabit Data Service) - a high-speed, datagram-based, public data network service expected to be widely used by telephone companies in their data networks.

SMTP (Simple Mail Transfer Protocol) - the Internet electronic mail protocol used to transfer electronic mail between hosts.

SNAP - SubNetwork Access Protocol

SNMP (Simple Network Management Protocol) - the Internet standard protocol for managing nodes on an IP network.

snmpd - an SMNP agent for a given adapter card.

SONET (Synchronous Optical Network) - a new and growing body of standards that defines all aspects of transporting and managing digital traffic over optical facilities in the public network.

Source Traffic Descriptor - a set of traffic parameters belonging to the ATM Traffic Descriptor used during the connection set-up to capture the intrinsic traffic characteristics of the connection requested by the source.

Spanning Tree Protocol - provides loop-free topology in a network environment where there are redundant paths.

SPANS (Simple Protocol for ATM Network Signalling) - FORE Systems' proprietary signalling protocol used for establishing SVCs between FORE Systems equipment.

SPARC (Scalable Processor Architecture Reduced instruction set Computer) - a powerful workstation similar to a reduced-instruction-set-computing (RISC) workstation.

SPE (Synchronous Payload Envelope) - the payload field plus a little overhead of a basic SONET signal.

SPVC (Smart PVC) - a generic term for any communications medium which is permanently provisioned at the end points, but switched in the middle. In ATM, there are two kinds of SPVCs: smart permanent virtual path connections (SPVPCs) and smart permanent virtual channel connections (SPVCCs).

Static Route - a route that is entered manually into the routing table.

Statistical Multiplexing - a technique for allowing multiple channels and paths to share the same link, typified by the ability to give the bandwidth of a temporarily idle channel to another channel.

STM (Synchronous Transfer Mode) - a transport and switching method that depends on information occurring in regular and fixed patterns with respect to a reference such as a frame pattern.

STP (Shielded Twisted Pair) - two or more insulated wires that are twisted together and then wrapped in a cable with metallic braid or foil to prevent interference and offer noise-free transmissions.

STS (Synchronous Transport Signal) - a SONET electrical signal rate.

Sublayer - a logical subdivision of a layer.

Super User - a login ID that allows unlimited access to the full range of a device's functionality, including especially the ability to reconfigure the device and set passwords.

SVC (Switched Virtual Circuit (or Channel)) - a channel established on demand by network signalling, used for information transport between two locations and lasting only for the duration of the transfer; the datacom equivalent of a dialed telephone call.

Switched Connection - a connection established via signalling.

Symmetric Connection - a connection with the same bandwidth value specified for both directions.

Synchronous - signals that are sourced from the same timing reference and hence are identical in frequency.

Systems Network Architecture (SNA) - a proprietary networking architecture used by IBM and IBM-compatible mainframe computers.

T1 - a specification for a transmission line. The specification details the input and output characteristics and the bandwidth. T1 lines run at 1.544 Mbps and provide for 24 data channels. In common usage, the term "T1" is used interchangeably with "DS1."

T3 - a specification for a transmission line, the equivalent of 28 T1 lines. T3 lines run at 44.736 Mbps. In common usage, the term "T3" is used interchangeably with "DS3."

Tachometer - in *ForeView*, the tachometer shows the level of activity on a given port. The number in the tachometer shows the value of a chosen parameter in percentage, with a colored bar providing a semi-logarithmic representation of that percentage.

TAXI (Transparent Asynchronous Transmitter/Receiver Interface) - Encoding scheme used for FDDI LANs as well as for ATM; supports speeds of up to 100 Mbps over multimode fiber.

TC (Transmission Convergence) - generates and receives transmission frames and is responsible for all overhead associated with the transmission frame. The TC sublayer packages cells into the transmission frame.

TCP (Transmission Control Protocol) - a specification for software that bundles and unbundles sent and received data into packets, manages the transmission of packets on a network, and checks for errors.

TCP/IP (Transmission Control Protocol/Internet Protocol) - a set of communications protocols that has evolved since the late 1970s, when it was first developed by the Department of Defense. Because programs supporting these protocols are available on so many different computer systems, they have become an excellent way to connect different types of computers over networks.

TDM (Time Division Multiplexing) - a method of traditional digital multiplexing in which a signal occupies a fixed, repetitive time slot within a higher-rate signal.

Telnet - a TCP/IP protocol that defines a client/server mechanism for emulating directly-connected terminal connections.

Token Ring - a network access method in which the stations circulate a token. Stations with data to send must have the token to transmit their data.

topology - a program that displays the topology of a FORE Systems ATM network. An updated topology can be periodically re-displayed by use of the interval command option.

Traffic - the calls being sent and received over a communications network. Also, the packets that are sent on a data network.

Trailer - the protocol control information located at the end of a PDU.

Transit Delay - the time difference between the instant at which the first bit of a PDU crosses one designated boundary, and the instant at which the last bit of the same PDU crosses a second designated boundary.

trap - a program interrupt mechanism that automatically updates the state of the network to remote network management hosts. The SNMP agent on the switch supports these SNMP traps.

UAS (Unavailable Seconds) - a measurement of signal quality. Unavailable seconds start accruing when ten consecutive severely errored seconds occur.

UBR (Unspecified Bit Rate) - a type of traffic that is not considered time-critical (e.g., ARP messages, pure data), allocated whatever bandwidth is available at any given time. UBR traffic is given a "best effort" priority in an ATM network with no guarantee of successful transmission.

UDP (User Datagram Protocol) - the TCP/IP transaction protocol used for applications such as remote network management and name-service access; this lets users assign a name, such as "RVAX*2,S," to a physical or numbered address.

Unassigned Cells - a generated cell identified by a standardized virtual path identifier (VPI) and virtual channel identifier (VCI) value, which does not carry information from an application using the ATM Layer service.

UNI (User-to-Network Interface) - the physical and electrical demarcation point between the user and the public network service provider.

UNI 3.0 - the User-to-Network Interface standard set forth by the ATM Forum that defines how private customer premise equipment interacts with private ATM switches.

UPC (Usage Parameter Control) - the mechanism that ensures that traffic on a given connection does not exceed the contracted bandwidth of the connection. UPC is responsible for policing or enforcement. UPC is sometimes confused with congestion management, to which it is functionally related on the *CellPath* 300 (*see* congestion management).

UTP (Unshielded Twisted Pair) - a cable that consists of two or more insulated conductors in which each pair of conductors are twisted around each other. There is no external protection and noise resistance comes solely from the twists.

V.35 - ITU-T standard describing a synchronous, physical layer protocol used for communications between a network access device and a packet network. V.35 is most commonly used in the United States and Europe, and is recommended for speeds up to 48 Kbps.

VBR (Variable Bit Rate) - a type of traffic that, when sent over a network, is tolerant of delays and changes in the amount of bandwidth it is allocated (e.g., data applications).

VC (Virtual Channel (or Circuit)) - a communications path between two nodes identified by label rather than fixed physical path.

VCC (Virtual Channel Connection) - a unidirectional concatenation of VCLs that extends between the points where the ATM service users access the ATM Layer. The points at which the ATM cell payload is passed to, or received from, the users of the ATM Layer (i.e., a higher layer or ATMM-entity) for processing signify the endpoints of a VCC.

VCI (Virtual Channel Identifier) - the address or label of a VC; a value stored in a field in the ATM cell header that identifies an individual virtual channel to which the cell belongs. VCI values may be different for each data link hop of an ATM virtual connection.

VCL (Virtual Channel Link) - a means of unidirectional transport of ATM cells between the point where a VCI value is assigned and the point where that value is translated or removed.

VINES (Virtual Network Software) - Banyan's network operating system based on UNIX and its protocols.

Virtual Channel Switch - a network element that connects VCLs. It terminates VPCs and translates VCI values. The Virtual Channel Switch is directed by Control Plane functions and relays the cells of a VC.

Virtual Connection - an endpoint-to-endpoint connection in an ATM network. A virtual connection can be either a virtual path or a virtual channel.

Virtual Path Switch - a network element that connects VPLs, it translates VPI (not VCI) values and is directed by Control Plane functions. The Virtual Path Switch relays the cells of a Virtual Path.

VPT (Virtual Path Terminator) - a system that unbundles the VCs of a VP for independent processing of each VC.

VP (Virtual Path) - a unidirectional logical association or bundle of VCs.

VPC (Virtual Path Connection) - a concatenation of VPLs between virtual path terminators (VPTs). VPCs are unidirectional.

VPDN (Virtual Private Data Network) - a private data communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

VPI (Virtual Path Identifier) - the address or label of a particular VP; a value stored in a field in the ATM cell header that identifies an individual virtual path to which the cell belongs. A virtual path may comprise multiple virtual channels.

VPL (Virtual Path Link) - a means of unidirectional transport of ATM cells between the point where a VPI value is assigned and the point where that value is translated or removed.

VPN (Virtual Private Network) - a private voice communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

VT (Virtual Tributary) - a structure used to carry payloads such as DS1s that run at significantly lower rates than STS-1s.

WAN (Wide-Area Network) - a network that covers a large geographic area.

Warm Start Trap - a *CellPath* 300 SNMP trap that indicates that SNMP alarm messages or agents have been enabled.

Yellow Alarm - an alarm that occurs on a device when the signal from the device is not received at the far-end.

X.21 - ITU-T standard for serial communications over synchronous digital lines. The X.21 protocol is used primarily in Europe and Japan.

X.25 - ITU-T standard that defines how connections between DTE and DCE are maintained for remote terminal access and computer communications in PDNs. X.25 specifies LAPB, a data link protocol, and PLP, a network layer protocol. Frame Relay has, to some degree, superseded X.25. See also Frame Relay, LAPB, and PLP.

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